Centre de Coopération Internationale en Recherche Agronomique pour le Développement

Integrated Sink Enhancement Assessment

SOFT OR HARD LINKING WITH COST FUNCTIONS FROM OTHER MODELS: TRIALS AND PROPOSALS FOR A EUROPEAN INTEGRATED SINK ENHANCEMENT ASSESSMENT

Final report for WP 5700

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Contents

List of figures

Soft or hard linking with cost functions from other models:
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for a European Integrated Sink Enhancement Assessment

Introduction

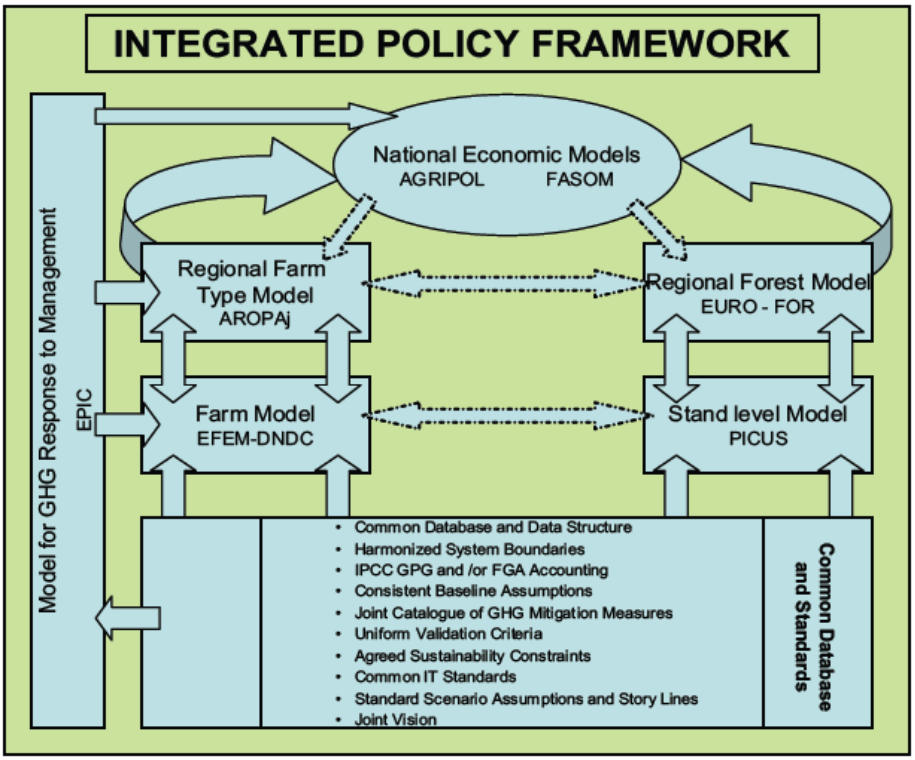
Among the key global public goods that require special attention and governance, the climate, the global food security, the protection of natural resources, and the supply of sustainable energy are unprecedented challenges. The Integrated Sink Enhancement Assessment (INSEA) project (http://www.iiasa.ac.at/Research/FOR/INSEA/INSEA_Broschure.pdf), a shared-cost action financed through the 6th Framework Program of the European Commission, aimed at an understanding of how the forestry and agricultural sectors contribute to the production of these public goods and, eventually, how these two sectors can contribute to a sustainable-development process by the adoption of environmental technologies mitigating anthropogenic greenhouse gas (GHG) emissions.

The originality of the INSEA project and consortium (12 multidisciplinary partners) was its combination of sector-specific tools cutting across a number of science and policy fields. Thereby, it aimed not only at quantifying ex ante the impacts of sector-specific strategies in climate, energy, agriculture, and forest policies, but also at the identification and quantification of a number of potential ancillary benefits and possible negative externalities of policy actions. By their very nature, land use, land-use change, and forestry (LULUCF) activities occupy space. Starting with a thorough analysis and modelling of the emission balance of agriculture, forestry and livestock activities as a function of technologies, the INSEA approach sought to integrate farm-level and forest-plot models with regional and national models for an assessment of the potential economic and environmental impacts of policy change (Figure 1).

However, as it was noticed before the beginning of the project, the INSEA bottom-up modelling approach has its limitations, especially because the boundaries of the systems are drawn in such a way that the behaviour of the aggregate markets has to be assumed exogenous. Consequently, a work package numbered 5700 (WP5700) aimed to help harmonizing the cost accounting methodology in such a way that consistency with cost functions and market price predictions (shadow price trajectories) from other sectors can be guaranteed. In this WP5700, the *Centre de Coopération Internationale en Recherche Agronomique pour le Développement* (CIRAD, France) was especially in charge to develop and use its model AGRIPOL with INSEA European data/results in order to establish links and consistency with the Global Emissions Control Strategies (GECS)'s modelling group. Indeed, within this group formed during the 5th Framework Program of the European Commission, the CIRAD built a static economic optimisation model using on the one hand regional expected

productions and resources availabilities as computed by IMAGE (NEAA, Netherlands: http://www.mnp.nl/image) according to GECS world scenarios, and delivering on the other hand regional marginal abatement cost (MAC) curves for agriculture (up to 2030) to other GECS' models like POLES (LEPII, France: http://web.upmf-grenoble.fr/iepe/). In other words, within INSEA, AGRIPOL's objective was mainly to establish consistency, coherence and dialogue with some world scenarios of population, economic growth and climate trend.

Figure 1. Overview of the linkages between INSEA modelling tools and databases.



This report summarizes the lessons drawn and the results obtained by the CIRAD during the INSEA project (2004-2006). These results are rather far from the ones expected: the development of AGRIPOL has to be put aside after one year of various meetings and parallel researches (2004) since it emerged that neither INSEA partners, nor other European organisations, would be able to deliver the key data for running the model: techno-economical information on current and potential agricultural practises. However, from this lesson came out another one: AGRIPOL could hardly run in Europe as elsewhere without an engineering cost model able to assess values missing either for the current technical packages, or for these packages after a rise of the fossil fuel price for example, or for packages not yet adopted but potentially profitable in future. While other INSEA partners were also realising the usefulness of such a tool (EU-FASOM, EFEM, AROPAJ, EPIC…), the CIRAD built it during the second half of the project, and it became the main contribution of CIRAD to INSEA. This report will therefore devote most of its pages to present this engineering cost model (see chapter 2 on "AGROPOL"), after a first chapter on AGRIPOL's configuration, results and current limitations for a European Integrated Sink Enhancement Assessment.

1. Linking agricultural GHG modelling to multi-sectors models and global scenarios

11. AGRIPOL's ambitions and modelling structure

The purpose of AGRIPOL (Deybe et Fallot, 2003) is to process available information on agricultural practices and constraints affecting production, to determine the sectoral response to a carbon price. Such incentive stands as a proxy of hypothetical climate policy willing to induce agriculture contributing to mitigation efforts. The approach aims at being consistent across world regions and sub-regions, and across activities to allow for comparisons of abatement potentials with other sectors.

AGRIPOL is a static economic optimisation model which can run for each of 40 world sub-regions. On the basis of estimations from an IAM IMAGE Business-As-Usual (BAU) scenario that provides by 2030 a coherent framework on population, economic growth and climate trends, the model considers a double constraint of production levels and of resources.

In its current version, AGRIPOL accounts for 8 major non-CO_2 GHG emitting activities[1], and only considers agricultural land uses. Analysing possibilities for policy-induced abatement in the agricultural sector implies to look for economically feasible processes where a lower level of emission can be attained using a different management of cropping systems, animal feeding, irrigation, or fertilizer dosing. The model focuses on emitting activities rather than on physical emission processes.

For each commodity, the representative agent, whose choice of practices is modelled, portrays the regional commodity producers which maximise their net revenue from the agricultural activities and minimise the risk associated with this choice, according to the attitude prevalent amongst commodity producers. In vectorial terms, this core specification of the model can be summarised in:

$$\text{MAX } \text{Re}venue - \frac{1}{2}\alpha.\sigma^2 - CC$$

subject to :

$$\sum_{act}\sum_{tech} Coeff_{act,tech,res} \leq \text{Re}sources_{res}(BAUscenario \text{ and } othersources)$$

$$\sum_{act}\sum_{tech} Emissions_{act,tech} \geq 0$$

$$\sum_{tech} Yield_{act,tech} = Expected\_production_{act}(BAUscenario)$$

where
- 'Revenue' is the outcome of income less fixed and variable costs plus subsidies and other revenues;
- 'σ^2' the expected possible deviation of income;
- 'α' the risk aversion coefficient[2] exogenously determined;
- 'CC' the carbon price.

[1] Dairy livestock producing milk and emitting CH_4 and N_2O, non-dairy livestock producing beef and emitting CH_4 and N_2O, rice production as a source of CH_4, three N_2O emitting crop productions, pastures or grassland management. World wide livestock productions, rice plantations and other fertilised crops, account for respectively 26%, 7% and 6% of land-use emissions according to IPCC (2001).

[2] α=0 if the farmers of a given commodity are risk takers, α>0 if risk averse

‘Coeff’ is the matrix of technical coefficient, and the vector ‘Resources’ accounts for endowments. Indices ‘act’, ‘tech’ and ‘res’ respectively stand for agricultural activities, practices, and resources.

Risk is represented through the variance of gross margins traducing uncertainty linked to both climate and choices of practices. Co-variances are assumed to be zero. Parameter α also allows the calibration of the model to fit with the estimations from the BAU scenario on land use and with expert sayings on the diversity of technological choice for each commodity in each region. The corresponding choice of activity intensity at each technical level is a linear function of C cost and non linear of risk, as in standard optimisation models with risk (Gérard *et al.*, 2000).

Constraints refer to resource endowments:
- land (arable, grazing or forest);
- inputs (for crop cultivations);
- skilled labour, that may become a limiting factor when activities become technically more sophisticated;
- unskilled labour;
- capital that may be a limiting factor when heavy investments are required;
- and two endogenously available resources: feed for animal (livestock activities), of which cereals whose production requires corresponding areas to be reassessed, and grassland.

Only land availability is currently binding the model, because of the lack of precise information on most of the resources. The equations on the other resources are used for "metering", accounting for the quantity of resources required, to eventually check consistency with other models’ results.

Data on average GHG emissions by activity was firstly looked for in the IPCC Guidelines for National Inventories, the reference manual for Agriculture. The impact of technological choices on emissions levels was then investigated among experts under the umbrella of the European Climate Change Programme (ECCP) working group Agriculture and of the non-CO_2 GHG network, and to a lesser extent, of the OECD group on soil carbon indicators and the FAO initiatives (experts consultation, forum) on carbon sequestration. For each activity, energy consumption is also considered as an indirect CO_2 source, so as to balance the attractiveness of processes that would be CH_4 or N_2O saving but also energy-intensive. Extrapolation was worked out from data available in published and discussed reports, or recomputed from own local sources. Economic data are composed of operational costs and structural costs, prices that multiply yields (that also multiply yields variances to give income variances) and additional revenues and subsidies accounting for agricultural policies.

The simulation entirely lies on responses to the carbon price. C price directly affects the variable costs: it multiplies emission levels by activity and technical level, thus modifying net economic margins. It also affects indirectly fixed costs, when the less emitting practices require capital investments. When the carbon price is modified: within each activity, substitutions take place between practices, such substitutions may modify land requirements for the different activities and grassland. The model allows to incorporate forest and grassland into arable land, explicitly considering substitutions in land uses.

12. Experimental runs and results for the EU15 countries

With few data and too many assumptions or extrapolations, AGRIPOL ran experimentally for the EU-15 countries, and worked out the results presented hereafter (Figure 2). Before debating the main limitation of AGRIPOL, and suggesting in chapter 2 a new tool to overcome the latter, we can briefly comment the AGRIPOL results:

(1) The abatement potentials seem quite limited : in France for instance, it would not be more than 1% of the agricultural emissions with a rather high fare of 195 €/tC-equ. (0,35% with a fare of 50 €), whereas these agricultural emissions are themselves already important: 27 millions tons of C-eq in 2000 as per the official figure declared by France (12 with the current version of AGRIPOL), or 18% of the national emissions and nearly a quarter of the total European agricultural emission (http://reports.eea.eu.int).

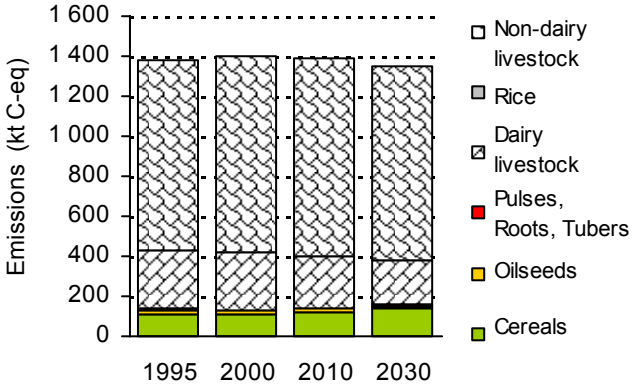
(2) All things being equal[3], and with few exceptions (Italy, Sweden, or even Austria), this abatement potentials would be even more limited in the future (2030 horizon), a rather intuitive result when we know that the food demand and the land supply are rather inelastic.

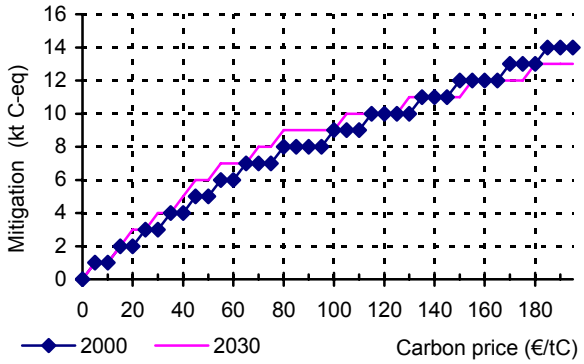
(3) The brunt of abatement would be tapped in the milk activity, as the current state of the art in agricultural mitigation techniques already taught us: significant quantities of methane per litre of milk can indeed be reduced by substituting as far as possible the cellulosic forages produced on low emitting pastures, with feeds richer in digestible energy and proteins, i.e. feed produced on higher emitting lands than pastures.

[3] Including here the non-development on a large scale of bio-fuels based on agriculture or forestry

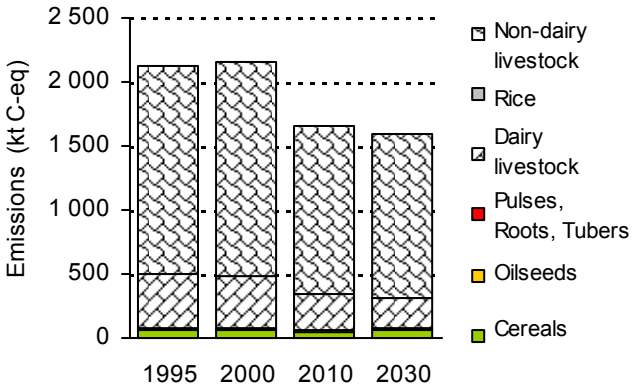
Figure 2. Emissions and mitigations of GHG by Agripol for the EU-15 countries (2000-2030)

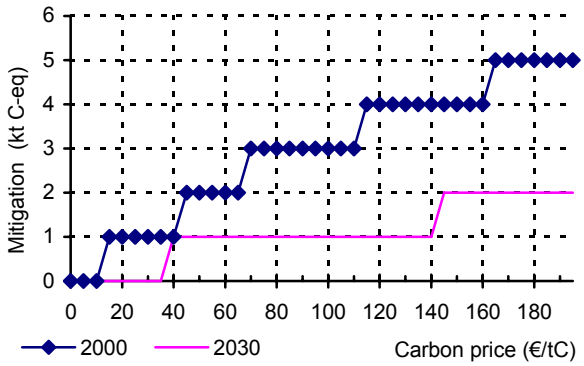
Austria



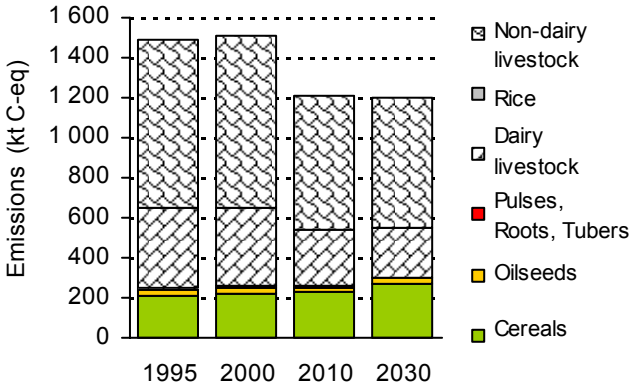


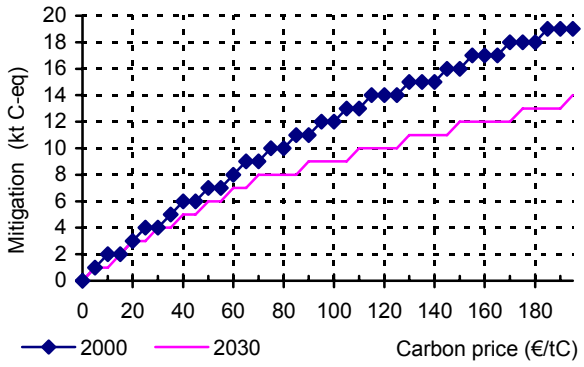
Belgium & Luxembourg



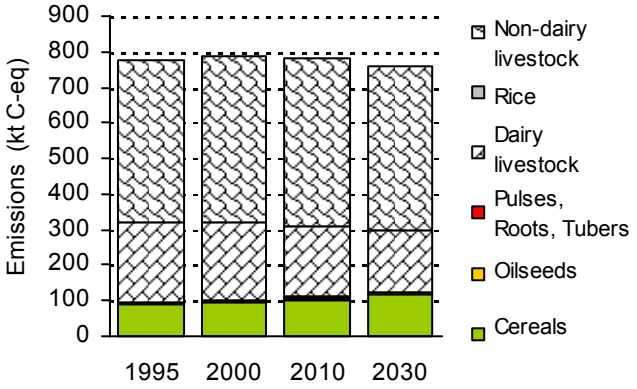


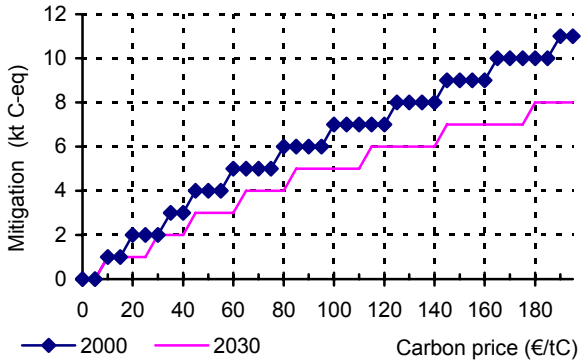
Denmark



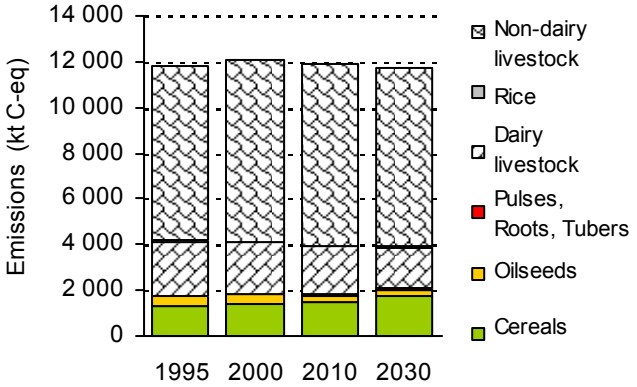


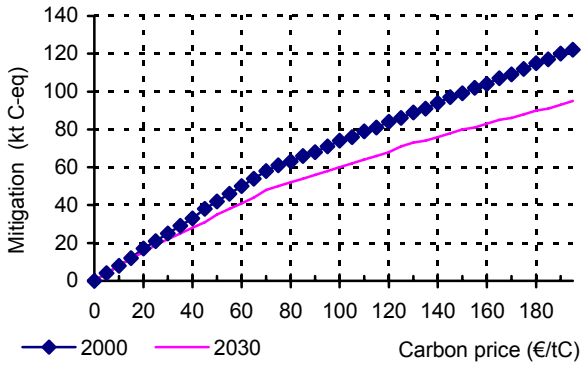
Finland



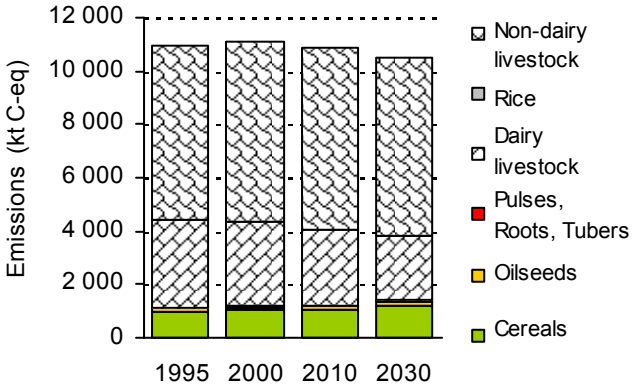


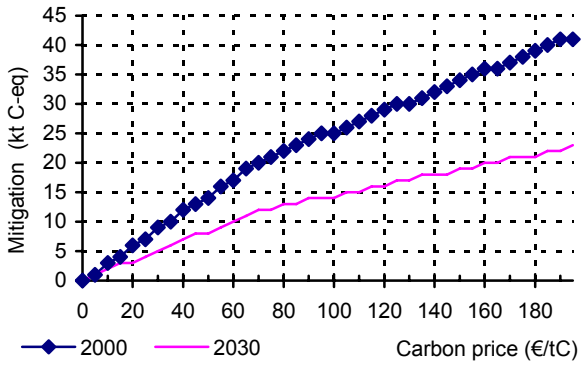
France



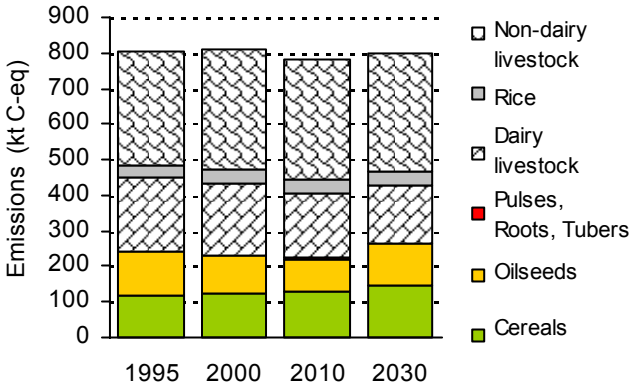


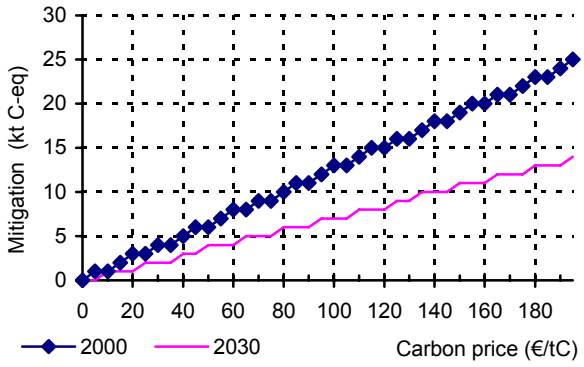
Germany



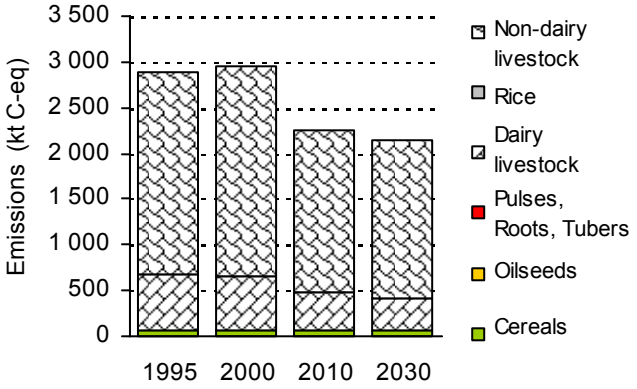


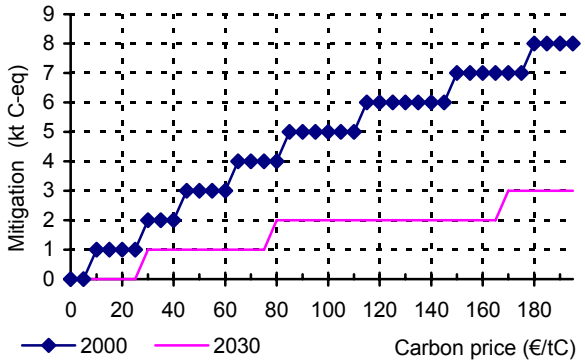
Greece



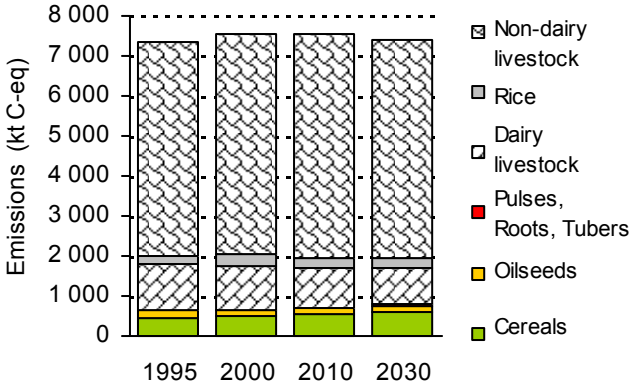


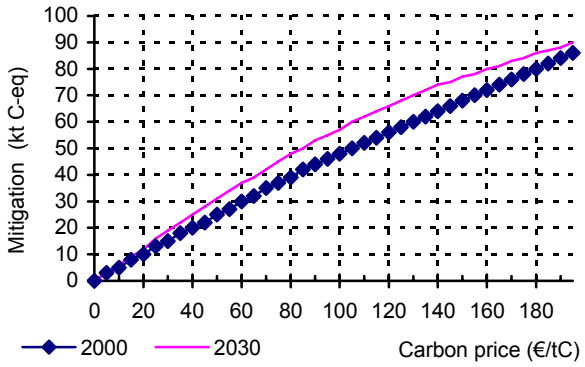
Ireland



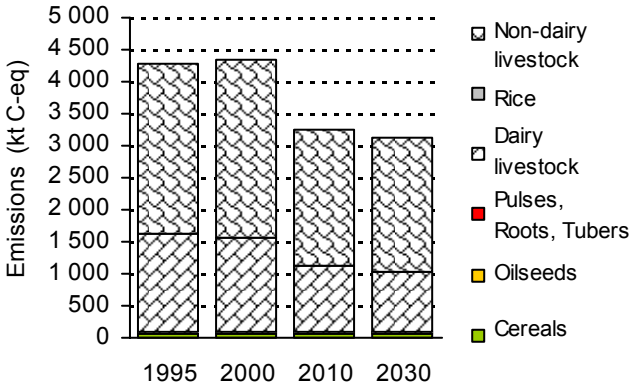


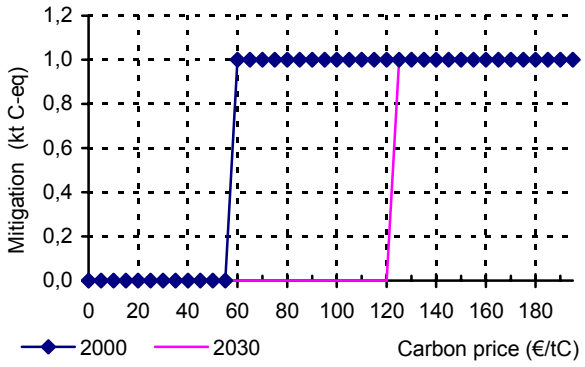
Italy



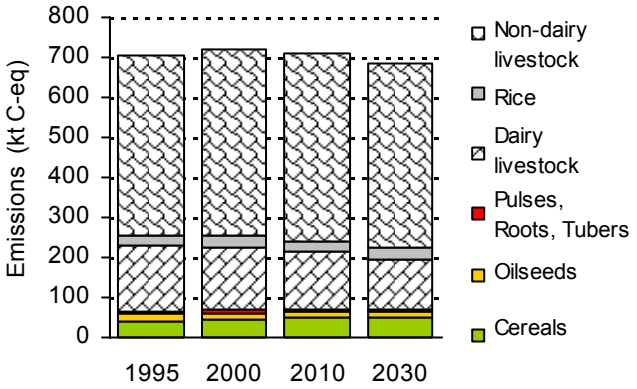


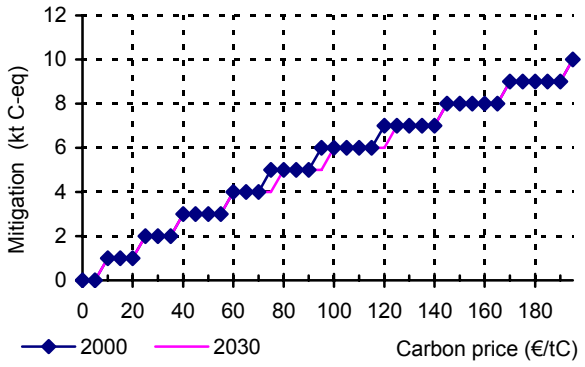
Netherlands



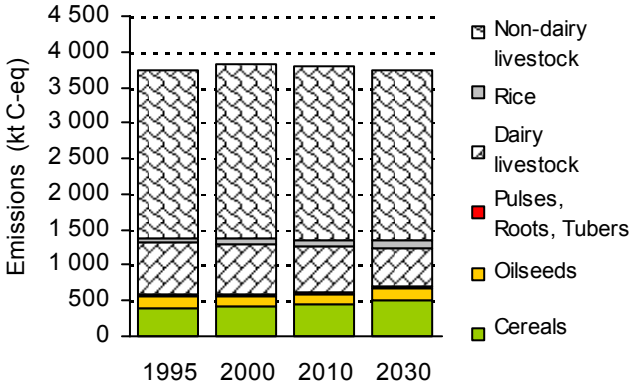


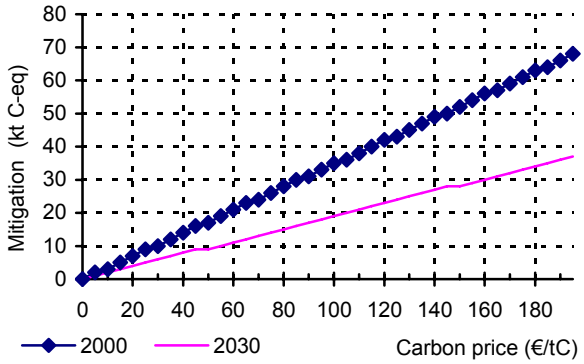
Portugal



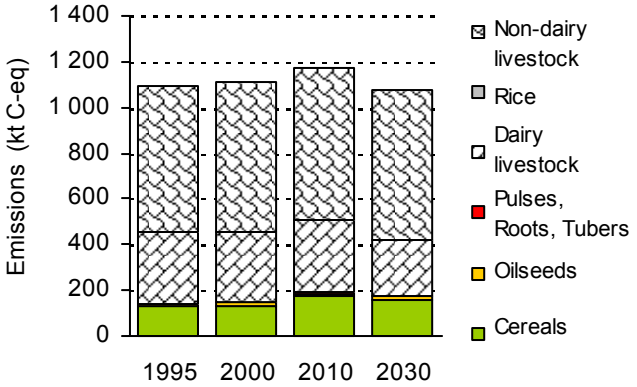


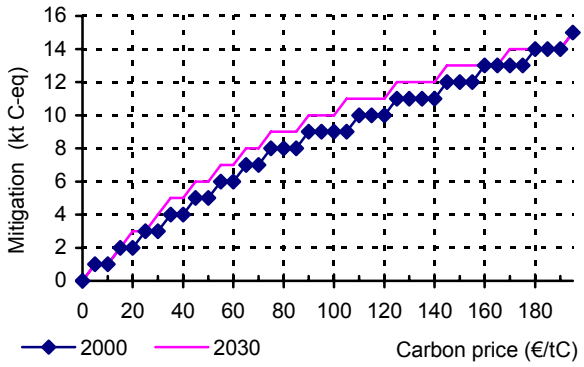
Spain



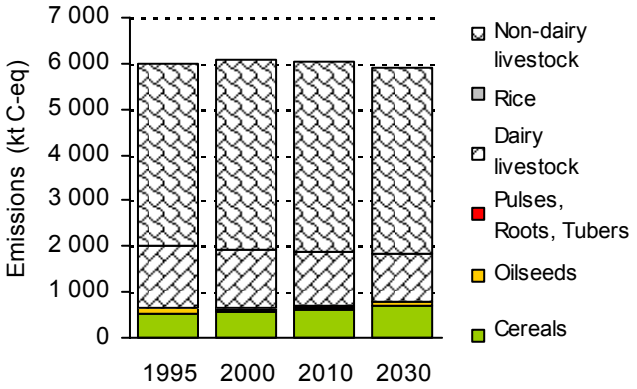


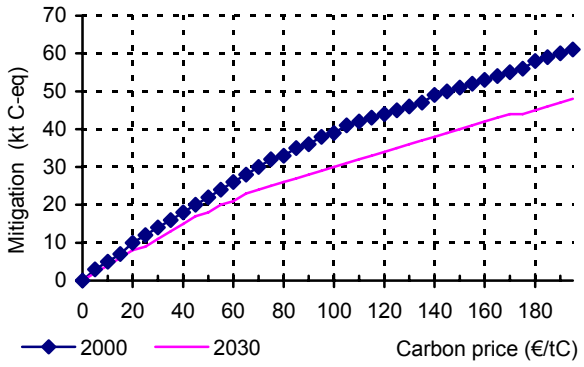
Sweden





United-Kingdom





13. Methodological difficulties and data limitations

The crucial challenge of AGRIPOL was to identify per region and per production (8 in the current version) few archetypes of technical packages reflecting not only the diversity of the current techniques, but also future technical options for mitigating agricultural GHG emissions.

To deal with this complex question, factors driving the GHG emissions for each activity have first been identified from the current state of the art (Figure 3). Then these factors, in a second stage, have been combined in such a way that for each activity, emerge four archetypes of technical packages successively called "basic", "improved", "advanced" and "optimized" (Annexe 1).

Figure 3. Factors driving the GHG agricultural emissions

Source : Deybe and Fallot (2002)

ACTIVITIIES	VARIABLES	MODALITIES
Livestock	Animal type	*Breeding ; High genetic merit cow ; Younger slaughter*
	Feeding type	*Silage ; Grains ; NSC ; Extra fat ; Propionate precursors*
	Feeding mode	*Increased feed intake ; In feedlots (≠ outdoor only) ; Optimal level of intake ; Physical treatment ; Chemical treatment*
	Manure storage mode	*Indoor ; Removed from stable ; Removed and stored in cool*
	Manure recycling	*Handled to fertilize fields ; In farmscale biodigester ; In centralised biodigester*
Rice crop	Water supply	*Non-irrigated ; Irrigated continuously flooded ; Irrigated with drainage ; Deep water*
	Cultivar	*Unspecified ; Low CH_4 emitting*
	Fertilization	*Organic matter ; Optimised organic amendment ; Mineral fertilizer (urea...) ; Sulfate-containing*
	Cultural operation	*Transplanting ; Direct seeding ; Wet tillage*
Fertilized crops	Fine tuned application	*Enhanced spreader maintenance ; Optimised distribution geometry ; Site specific application*
	Nitrogen control	*Soil testing ; Allowing for manure N + residual N ; Tools to measure N status of crop*
	Targeted Fertilization	*Split application ; Controlled release fertilisers ; Nitrification inhibitors ; Liquid or powder form of fertiliser ; Slurry injection ; Foliar application*
	Other	*Fertiliser free zone ; Minimise fallow periods ; Water management*
Pasture land	Pasture type	*Deep-rooted herbs ; Optimised distribution geometry*
	Fine tuned agriculture	*Enhanced spreader maintenance ; Optimised distribution geometry ; Site specific application*
	Nitrogen control	*Soil testing ; Tighten N flow cycle ; Tools to measure N status of crop*
	Targeted Fertilization	*Split application ; Controlled release fertilisers ; Nitrification inhibitors ; Liquid or powder form of fertiliser*
	Other	*Increase in the cutting frequency ; Fertiliser free zone*

In a third problematic stage, the following points were assumed:

- those archetypes correspond to four increasing yield levels;
- higher is the yield, higher the production costs are (fixed and variable) ;
- higher is the yield, lower is the statistical variance risk ;
- higher is the yield, higher are the energy consumption (per hectare or per animal) and the GHG emissions, except for the « optimized" archetype whose values are lower than in the « advanced » one, or even in the « basic » one as far as the CH_4 or N_20 emissions are concerned.

Thus, when more fixed capital or input are used, higher is the yield, lower is the dependence on natural vagaries ("artificialization" of the environment), and more GHG are emitted except for the « optimized » archetype which direct aim is to mitigate them (Figure 4).

This typology is conceptually quite attractive, but looks also as a very ad hoc one, especially when we know that:
- the rare existing techno-economic data-banks have not been designed for reporting agricultural GHG emissions ;
- the state of the art on agricultural mitigation techniques (Figure 3) very rarely reports their impact on the yields and, above all, on the costs.

Figure 4. The four AGRIPOL archetypes of agricultural practices

	Basic	Improved	Advanced	Optimum
Use of mitigation techniques	+/-	+	++	+++
Yield	+	++	+++	++++
Costs (fixed and variable)	+	++	+++	++++
Fossil fuel consumption	+	++	+++	++++
GHG emissions	+	++	+++	++ or +++
Yield variance	++++	+++	++	+

To deal with that major difficulty (lack of data), various experimental and unsatisfactory solutions have been worked out to run the model. These solutions are detailed and discussed elsewhere (Dorin, 2005), along with:
- other problematic issues (categorization of the agricultural activities, risk aversion and calibration, GHG sink/emission accounting, exogenous prices, organisation and management of the data, etc.);
- a search for of a better typology of current and potential agricultural systems.

This latter research investigated various studies, from small regions to global scale, from the Neolithic period to the modern times: Carpy-Goulard (2001), Malassis and Padilla (1986) along with Mazoyer and Roudart (1997), Buteault *et al.* (1988) along with Desbois (2000) and Pollet *et al.* (2001), Dixon *et al.* (2001a, 2001b) and the Millennium Ecosystem Assessment (MEA, 2005). But despite their great respective teachings, none of these studies brought us a realistic solution for AGRIPOL, whereas they confirmed the urgent need for a tool able to record and/or assess simultaneously costs and environmental externalities of agricultural practices.

The next chapter shows how we started to work on this latter agenda, leaving behind an unfinished one for AGRIPOL (Figure 5).

Figure 5. AGRIPOL's unfinished agenda

		Illustrations	Comments
INPUTS OF AGRIPOL			
1	Regional production volumes	Cereals ; Oil seeds and pulses ; Roots and tubers…	Observed (Fao, Eurostat…), simulated by models (SRES/Image, etc.) , or policy targets
2	Regional production prices	Hard and soft wheat ; Rice ; Soybean ; Rapeseed… ; Bio-fuels ; Timber…	Observed (Fao, Fadn…) or simulated by models
3	Regional constraints on factors	Land ; Water ; Labour ; Capital ; Industrial inputs…	Not often quoted in models, except for land
4	Environmental policy content	GHG pricing ; Sink subsidies ; Quotas…	Range of options to be simulated
AGRIPOL MODELLING			
1	Adoption of proven techniques not changing the farming system (FS)	No tillage ; Integrated Agriculture ; More digestible animal feed…	As often tested in many models
2	Adoption of not yet proven techniques but not changing the FS	GMO…	Lack of information (on future technical progress, on social reactions….)
3	Adoption of techniques restructuring the FS	Direct sowing Mulch-based system ; Agroforestry…	Change of Farm-type
4	Bio-fuel productions		With or without Farm-type change
5	Afforestation	Sanctuarization ; Woodfuel ; Pulpwood , Timber…	With or without Farm-type change
OUTPUTS OF AGRIPOL			
1	Land use change	-	Due to exogenous constraints on volumes and prices as specified above
2	Detailed GHG budget	C, CO_2, CH_4, N_20	Taking into account processing, transport etc. Implying indirect emissions/sequestrations
3	MAC curves for agriculture	Price and volume of GHG abatement	To be fed into other models (Poles, Gem3…)
4	Assessment of other environmental externalities	Erosion ; biodiversity ; pollution…	Indicators
5	Revelation of the underlying assumptions of various models	Availability in capital ; Agricultural employment…	
6	Various simulations after a squeeze or a slackening of the constraints	-	Need of a «User-friendly» interface for policy-makers

2. An engineering cost model for agriculture and forestry: AGROPOL

21. Ambitions of AGROPOL

Chapter 1 displayed the experimental AGRIPOL results for the EU-15 countries, as well as the limitations which hinder any major improvement if no engineering cost model can be used. In this chapter 2, we show how should look likes such a tool whose prototype version has been named « AGROPOL ».

Thanks to INSEA interplays, five main functions have been identified for « AGROPOL ».

(1) Registration of agricultural and forestry practices
The tool should before all be for referencing and keyboarding :
- the main features of an ecosystem where an agricultural or forestry activity take place (country, types of soil, type of climate, topography, farm size, etc);
- the types and volumes of factors used by this activity (assets, human labour, animal power, inputs…), along with the technical practice (sequence of operations during few months or several years) and the outputs coming out from this technical package (volumes of products and by-products).
The keyboarding should be precise enough to allow the computations detailed below, but also simple enough not only to welcome various forms of language and expertise (farmers, experts, observatories, …), but also to minimize as far as possible the keyboarding time.

(2) Assessment of costs and margins
On the basis of the previous information , as also with the help of database such as TRAME (BCMA, 2004), the tool should then assess :
- the fixed costs (depreciation, interest on the residual value of immobilized capital, insurance, shelter…),
- the variable costs (repair and maintenance of assets, human and animal labour, seeds or plants, organic and mineral fertilizers, pesticides, water, fuel and electricity…).
- the gross and net margins.
This assessment should use exogenous prices either directly keyboarded, or imported from existing databanks. In any case, it should always be possible in AGROPOL to reassess costs, incomes and profits after a change of some important economic parameters (fuel price, commodity price, wages, discount or borrowing or rate, etc.).

(3) Interplay with bio-physical models
AGROPOL should also be able to interplay with bio-physical models such as EPIC, in order to recomputed, from few observed practices, costs and margins of the latter in case of other soil, other climate, other dose of nitrogen fertilizers or of water, other tillage practice, etc.

(4) Assessment of environmental externalities
One of the most innovative and complex function of AGROPOL should be to assess some environmental externalities with methodologies rather well-accepted and not requiring a large set of data. For the GHG emission/sink, the methodology tier1 and/or tier2 of the IPCC (IPCC, 1996, 2001, 2003a, b) could be used and combined with some other implemented for Life Cycle Analyses.

(5) Interplay with economic models
Lastly, AGROPOL should be used to identify archetypes of technical packages for running models such as AGRIPOL or EU-FASOM.

In other words, AGROPOL could help:
(1) to built a unique databank on the world agricultures practices;
(2) to transform contextual information into matrices useful for economic models;
(3) to better compare the productive (biomass), economic (income), social (employment), and environmental (GHG, water...) advantages of various goods and of various ways to produce them, today or in the future, here or there in the world;
(4) to simulate the impact of a rise in fossil fuel prices on motorized and chemical agricultures;
(5) etc.

The expected outputs of AGROPOL are therefore more limited and wider in scope than the « Budget Generators » developed in the USA[4] and more rarely elsewhere in the world: SIMEQ in France by the *Institut du Végétal* (Arvalis), SILAS in Swiss by Malitius and Mack (Fischer, 1999), TECHNOGIN for East-Asia and for South- East Asia by Ponsioen and al. (2003), BEE for bio-fuels by the Athens Agricultural University (www.adira.gr/Bee_web/index.asp), OLYMPE by INRA and CIRAD (http://www.grignon.inra.fr/economie-publique/olympe/olympe.htm)...

However this tool does not go beyond being an engineering model which does not endogenize the supply and demand effects. In its initial state, it would be a simulation model, but not an optimization model, though it could become so in a further step of development. Lastly, its value and usefulness will largely rely on the number and the variety of technical practices keyboarded as well as multiplied by bio-physical models such as EPIC.

15 [4] ISFM by USDA (Rotz et Coiner, 2005), CARE by Christensen & al. ; OKBUDS by Doye ; BUDPRO by Bevers, TRONSTAD by the Arizona University; PLANETOR by Hawkins & al. ; MACHSEL by Kletke and Sestak, ABS by Slinsky & Tiller (Slinsky et Tiller, 1999)

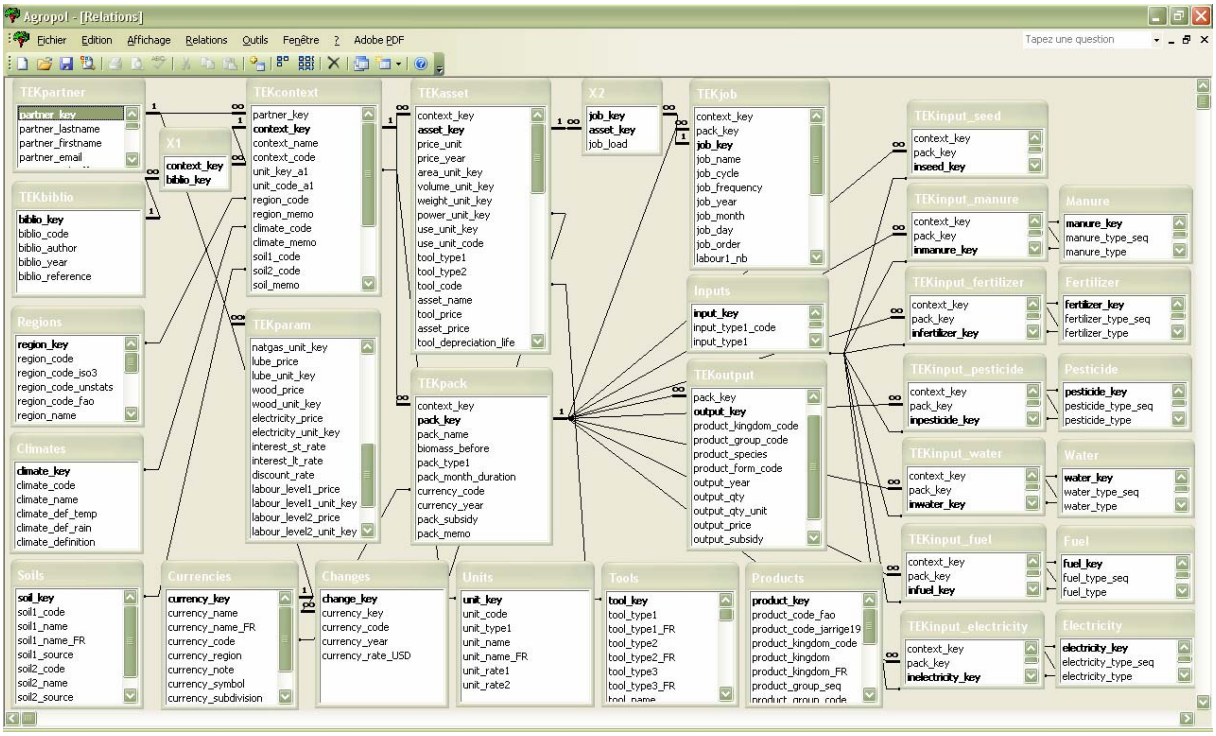
…

22. AGROPOL windows up to costs and incomes simulations

AGROPOL	GENERAL REMARKS

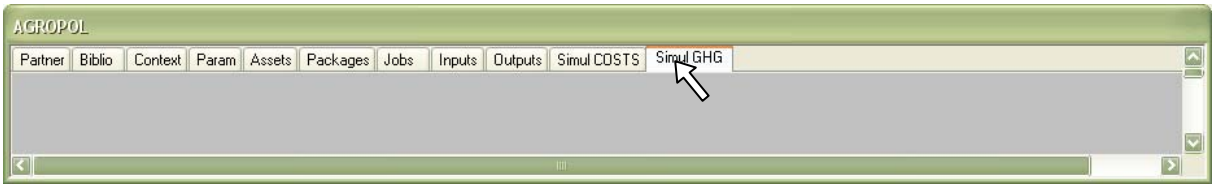
Data organisation

Agropol is a friendly-user interface built with Microsoft Office Access 2003 in order to manage data of various origins for various outputs. The organisation of these data into databases, as well as connections established between these data, are not user-friendly since it looks likes something like this:



Screens

Above all databases, connections, equations and code (Sql and Visual basic), the current Agropol interface has 10 operational screens which are alternatively emulated by a click on their names (“Partner”, “Biblio”, etc.) located on the top part of the Agropol window (see below). Some screens can not be emulated (grey colour screen) until some compulsory information are selected on other screens.



Buttons / Icons

The main buttons/icons of commands present on Agropol screens are the following ones:

 for “Delete a record”

 for “Duplicate a record”

 for “Add a new record”

Other buttons/icons will be extended or added in future Agropol versions, like:

 for “Print a report of the information mentioned on screen”

 for “Export data/results to Excel”

Units

A big effort of Agropol is to be not only a bilingual interface (English/French), but also a multi-unit environment: every value can be keyboarded or converted in the unit of his/her choice. The choices within each type of unit are, potentially, the following ones (default unit in grey colour):

Area▼

m2	meter ^2	mètre ^2
A	acre	Acre
Ha	hectare	Hectare
km2	kilometer ^2	kilomètre ^2
ft2	foot ^2	pied ^2

Distance▼

mm	millimeter	millimètre
cm	centimeter	centimètre
inc	inch	pouce
dm	decimetre	décimètre
ft	foot	pied
yd	yard	yard
m	meter	mètre
km	kilometer	kilomètre
mile	mile	mile
nm	mile (nautical)	mile (nautic)

Volume▼

cm3	centimeter ^3	centimètre ^3
inc3	inch ^3	pouce ^3
l	litre	Litre
gal	gallon (US)	gallon américain
gali	gallon (imperial)	gallon impérial
ft3	foot ^3	pied ^3
hl	hectolitre	Hectolitre
m3	metre ^3	mètre ^3
bbl	barrel	Baril
yd3	yard ^3	yard ^3

Weight▼

gr	gramme	gramme
oz	ounce	once
lb	pound	livre
kg	kilogramme	kilogramme
q	quintal	quintal
lmp	short ton	tonne américaine
t	metric ton	tonne

Unit▼

U	unit	Unité
Ku	thousand units	millier d'unités
Mu	million units	million d'unités
Gu	billion units	milliard d'unités

Time▼

hr	hour	heure
day	day	jour
week	week	semaine
mont	month	mois
yr	year	année

Energy▼

cal	calorie	Calorie
kcal	calorie (diet)	calorie (alimentaire)
j	joule	Joule
kj	kilo joule	kilo joule
btu	British thermal unit	Btu
mj	mega joule	mega joule
kwh	kilowatt-hour	kilowatt-heure
ther	therm	Therm
gj	giga joule	giga joule
tce	ton coal equivalent	tonne equivalent charbon
toe	ton oil equivalent	tonne équivalent pétrole
bboe	barel oil equivalent	baril de pétrole

Power▼

w	watt	watt
hpdin	horse power (metric)	cheval vapeur (DIN)
hp	horse power (UK,US)	horse power
kw	kilo watt	kilo watt

GHG▼

ce	C equivalent	C équivalent
co2e	C02 equivalent	CO2 équivalent
ch4e	CH4 equivalent	CH4 équivalent
n2oe	N2O equivalent	N2O équivalent

Rate▼

ppm	part per million	partie par million
o/oo	per thousand	pour mille
o/o	percentage	pourcentage

Currencies

Agropol also offers a multi-currency environment not only for data entry but also to facilitate comparisons of results between a region to another (costs, margins…). In the current Agropol version, 220 currencies are potentially available with their respective ISO-4217 code, but only 27 are currently displayed (see below): those for which we have compiled their annual exchange rate toward the dollar, from 1948 up to 2005 (PACIFIC, 2006). In this respect, when a monetary value (e.g. 34 000 EUR2004) is converted with Agropol into another one by a simple click (e.g. 45 893 EUR2000, or 77 216 BRL2000, or 42 196 USD2000…), it only indicates the value in US Dollars converted with the concerned exchange rate of the concerned year. In other words, local inflation rates are not taken into account here, and the USD exchange rate is always 1 from 1948 to 2005.

Currency▼

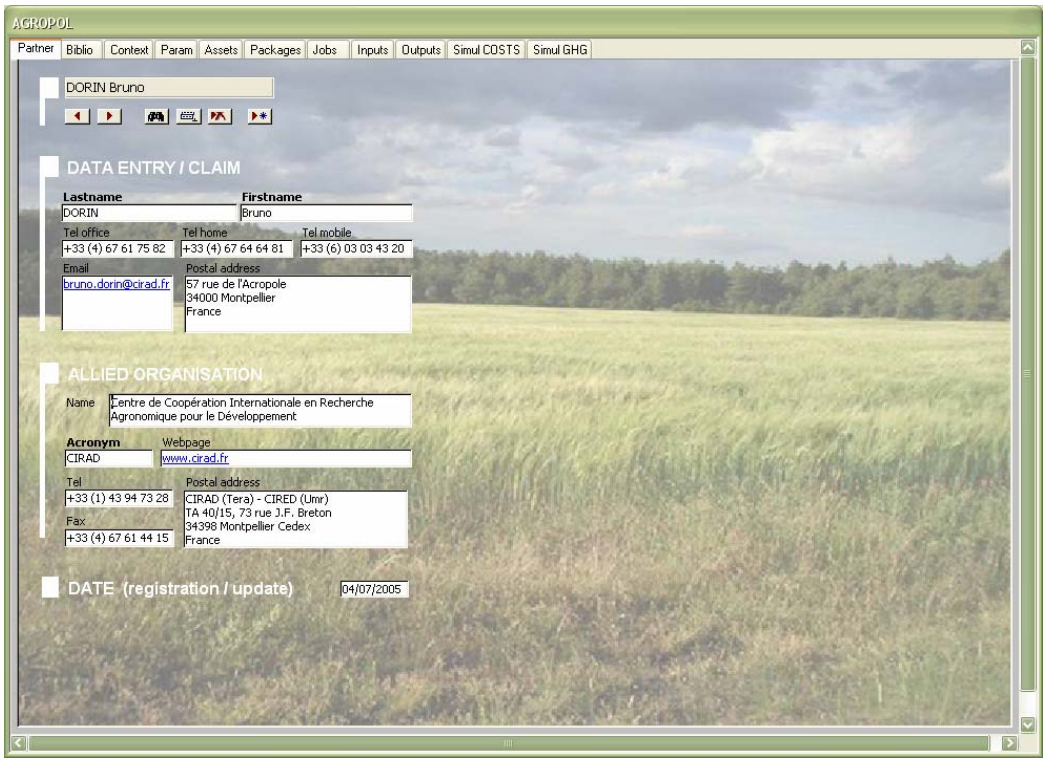
ATS	Schilling (Austrian)	Schilling (autrichien)	Austria [AT]
AUD	Dollar (Australian)	Dollar (australien)	Australia [AU], Christmas Island [CX], Cocos (Keeling) Islands [CC], Heard and McDonald Islar
BEF	Franc (Belgian)	Franc (belge)	Belgium [BE]
BRL	Real (Brazilian)	Real (brésilien)	Brazil [BR]
CAD	Dollar (Canadian)	Dollar (canadien)	Canada [CA]
CHF	Franc (Swiss)	Franc (suisse)	Liechtenstein [LI], Switzerland [CH]
DEM	Mark (Deutsche)	Mark (allemand)	Germany (West and East) [DE]
DKK	Krone (Danish)	Couronne (danoise)	Denmark [DK], Faroe Islands [FO], Greenland [GL]
ESP	Peseta (Spanish)	Peseta (espagnole)	Andorra [AD], Spain [ES], Western Sahara [EH]
EUR	Euro	Euro	Austria [AT], Belgium [BE], Finland [FI], France [FR], Germany [DE], Greece [GR], Ireland [IE
FIM	Markka (Finnish)	Markka (finlandaise)	Finland [FI]
FRF	Franc (French)	Franc (français)	Andorra [AD], France [FR], French Guiana [GF], French Southern and Antarctic Territories [TF
GBP	Pound (Sterling)	Livre (sterling)	British Indian Ocean Territory [IO], British Virgin Islands [VG], South Georgia and the South Sa
HKD	Dollar (Hong Kong)	Dollar (Hong Kong)	Hong Kong [HK]
IDR	Rupiah (Indonesian)	Rupiah (indonésienne)	Indonesia [ID]
INR	Rupee (Indian)	Roupie (indienne)	Bhutan [BT], India [IN]
ITL	Lira (Italian)	Lire (italienne)	Holy See (Vatican City State) [VA], Italy [IT], San Marino [SM]
JPY	Yen (Japanese)	Yen (japonais)	Japan [JP]
NOK	Krone (Norwegian)	Couronne (norvégienne)	Antarctica [AQ], Bouvet Island [BV], Norway [NO], Svalbard and Jan Mayen Islands [SJ]
NZD	Dollar (New Zealand)	Dollar (néo zélandais)	Cook Islands [CK], New Zealand [NZ], Niue [NU], Pitcairn Island [PN], Tokelau [TK]
PHP	Peso (Philippines)	Peso (philippin)	Philippines [PH]
PKR	Rupee (Pakistani)	Roupie (pakistanaise)	Pakistan [PK]
PTE	Escudo (Portuguese)	Escudo (portugais)	Portugal [PT]
SEK	Krona (Swedish)	Couronne (suédoise)	Sweden [SE]
SGD	Dollar (Singapore)	Dollar (sigapourien)	Singapore [SG]
THB	Baht (Thai)	Baht (thaïlandais)	Thailand [TH]
USD	Dollar (US)	Dollar (américain)	American Samoa [AS], British Virgin Islands [VG], Ecuador [EC], Federated States of Micronesi

AGROPOL screen 01 — PARTNER

Aims

Agropol's one ambitions is to be used for gathering data on agricultural and forestry practices all over the world, and later to offer to those who participate in the project a unique database for vary various kinds of analyses at the micro- or macro-levels, in the technical, economical and/or environmental fields. The aim of this screen 01 is to clearly identified the providers of data (a person along with its organisation if any), not only to fully recognise a work of key importance in spite of its unfortunate low-rate in certain arena (scholar world especially, where progresses in models or theories are far better rewarded), but also to allow future exchanges with data providers for questions or clarifications, and later for their access to other Agropol data. In other words, the function of this screen 01 is to establish rights on and traceability of the data. This screen will undoubtedly be improved in future Agropol's versions.

Visual aspect and screen sections



Details

A This **Name of partner** (locked cell) is automatically structured with last and first names of screen 01B. It shows how the data provider will be identified on Agropol screens, printings or exported files. When a name is selected in this list of names (thanks to the arrows on the underneath), it leads firstly to show on screen 01B/C its detailed information for verification or modification purposes, secondly to restrict all following Agropol use to data pertaining to this name only. Elements of this list of names can be deleted (with restrictions), duplicated (with restrictions) and/or enlarged (see buttons/icons just on the underneath).

B This section must be carefully filled in for reasons explained in above introduction. Future Agropol versions might include here a space for password definition/entry.

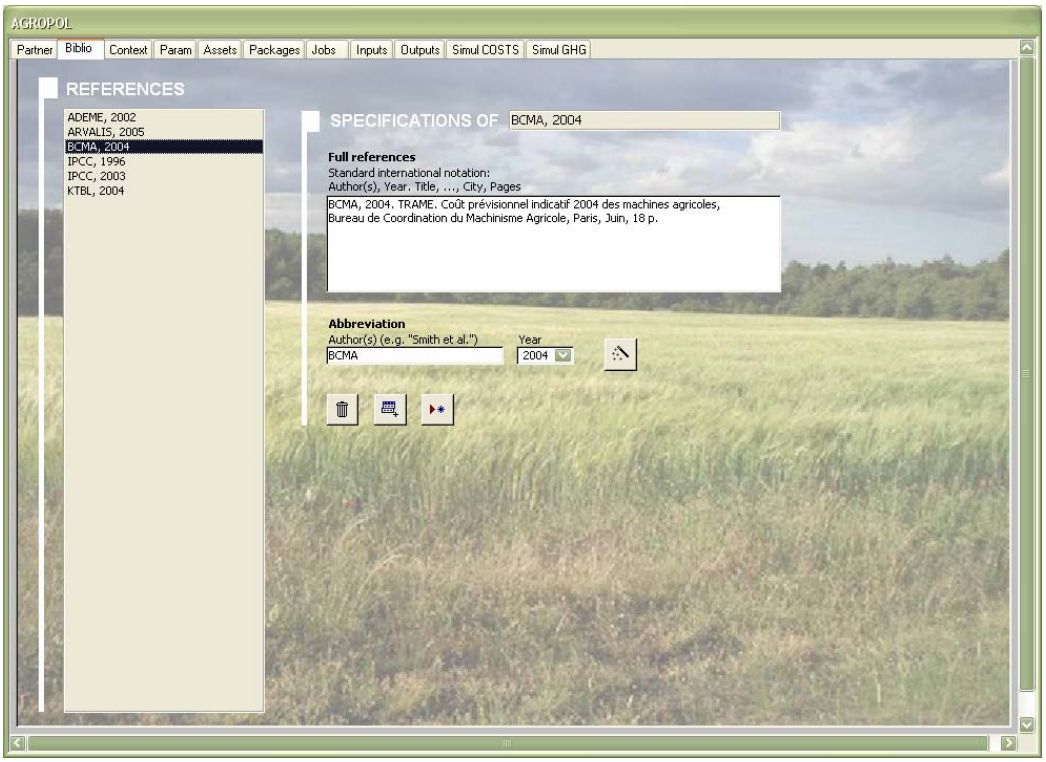
C The **Date** of registration is automatically filled in, but must be manually changed when information on data provider is updated.

AGROPOL screen 02 — BIBLIO

Aims

A “Partner” (screen 01) may keyboard some data which come from his/her own experience, and/or interviews, and/or also from various literature (scientific articles, reports, working papers, web pages, etc.). These sources of information must be mentioned to respect individual or collective intellectual properties. The aim of this screen 02 is therefore to register these bibliographic references according to current international standards, as well as to fulfil another Agropol ambition: to progressively build and enjoy an international bibliography on data useful for studying and analysing agricultural and forestry practices.

Visual aspect and screen sections



A

B

C

Details

A This **List of references** (locked cells) is accessible to any user, here as well as on other screens, and everyone is invited to enlarge it. When an element is clicked with the mouse, the details of the bibliographic reference is shown on the right side (screen 02B).

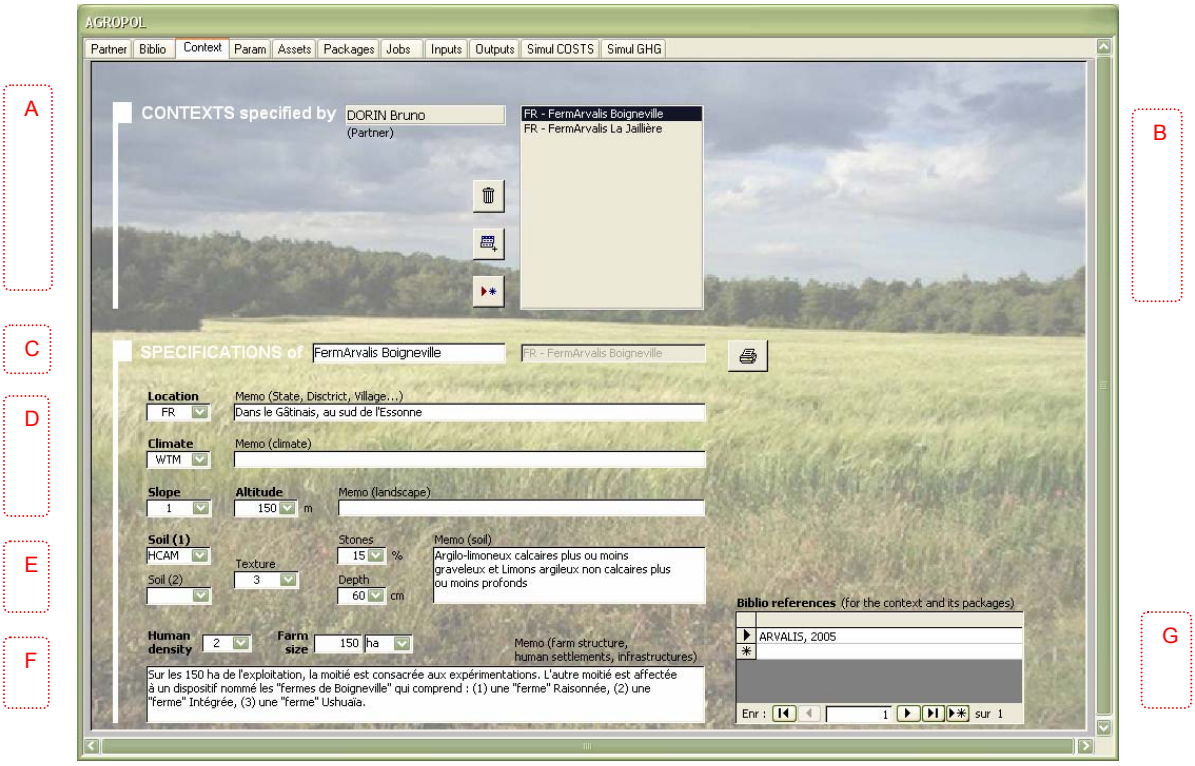
B The **Full bibliographic reference** are keyboarded in this space, and in such a way that it includes all elements and precisions required by international scientific journals. In future Agropol versions, this section might be improved to better guide and homogenise the bibliographic presentations (separate cells for names, year, title, publisher, town, pages, etc.).

C The **Abbreviation** section is important since it configures how the bibliographic reference will be quoted everywhere else. The length for “Author(s)” is rather short and must follow the standard presentation of bibliographic abbreviations.

Aims

Agricultural and forestry activities are embedded in very various ecosystems which are strong driving forces of these activities and their outputs, but also driven by these same activities and outputs. These key and complex ecosystems can be characterized by loads of information well beyond the scope of Agropol which challenge was to find a compromise between, on the one hand minimum information for some Agropol future assessments (e.g. estimate of greenhouse gas emission/sink) or for running more sophisticated tools (e.g. bio-physical models such as Epic) and, on the other hand, what a non-specialist is able to keyboard without spending hours to look for correct and precise information. This screen 03 is the tentative result of a compromise which is still open to debate (comments most welcomed).

Visual aspect and screen sections



Details

A The **Partner name** (locked cell) is automatically filled in according to the selection made on screen 01A,

B …and the **list of contexts** (locked cells) already keyboarded by this partner are listed on the right side, in alphabetic order. A click on one of these element displays its details on the underneath (screen 03C/D/E/F/G), and emulates most of other following Agropol screens which are, otherwise, kept frozen (grey screens). Elements of this list can deleted (with restrictions), duplicated (with restrictions) or enlarged (see buttons/icons on the left side).

C The **Context name** is keyboarded here in any language, the only restriction being that the text does not exceed 25 characters including blank spaces. This text is usually the name of a farm, or the name of a region with homogeneous agro-climatic, landscape and farm conditions. On the right side of this space is mentioned in a locked cell how the context name will appear in the list above as well as everywhere else in Agropol; this reference is valid only if the name given to the context is preceded (automatically) by the country code which is selected just below.

D In this section starts the keyboarding of minimum information on agro-climatic, landscape and farm conditions. The **Location** is informed by selecting first a country (combobox of 226 options ordered by the 2-letter country UN code) and then by typing in a "**Memo**" on the right side more precise information on the location. These Memos (without limits of length) are available for every following comboboxes (or group of comboboxes), here as well as in most other Agropol screens, to encourage the keyboarding (if possible in English or French languages) of any information not currently captured by Agropol, and potentially crucial for understanding a situation, or analysing later on some dimensions within or beyond Agropol scopes.
After the location of the Context, following comboboxes and memos are successively on:
- the **Climate**, with 9 options (IPCC, 2003b) (see combobox below);
- the **Slope**, with 3 options (see combobox below);
- the **Altitude**, with 4 options (FADN) (see combobox below); if the exact altitude is known, it can be keyboarded (in meters only) to replace the default value used for each option.

Location▼

CI	Côte d'Ivoire	Côte d'Ivoire
HR	Croatia	Croatie
CU	Cuba	Cuba
CY	Cyprus	Chypre
CZ	Czech Republic	Tchèque, République
DK	Denmark	Danemark
DJ	Djibouti	Djibouti
DM	Dominica	Dominique
DO	Dominican Republic	Dominicaine, République
EC	Ecuador	Équateur
EG	Egypt	Égypte
SV	El Salvador	El Salvador
GQ	Equatorial Guinea	Guinée équatoriale
ER	Eritrea	Érythrée
EE	Estonia	Estonie
ET	Ethiopia	Éthiopie
FO	Faeroe Islands	Féroé, Iles
FK	Falkland Is (Malvinas)	Falkland (Malvinas), Ile
FJ	Fiji Islands	Fidji, Iles
FI	Finland	Finlande
FR	France	France
GF	French Guiana	Guyane française
PF	French Polynesia	Polynésie française
GA	Gabon	Gabon
GM	Gambia	Gambie
GE	Georgia	Géorgie
DE	Germany	Allemagne
GH	Ghana	Ghana
GI	Gibraltar	Gibraltar
GR	Greece	Grèce

Climate▼

CTD	Cold temperate, dry	< 10°C	PET > Annual Precip
CTM	Cold temperate, moist	< 10°C	PET <= Annual Precip
WTD	Warm temperate, dry	10°C to 20°C	< 600 mm
WTM	Warm temperate, moist	10°C to 20°C	PET <= Annual Precip
TRD	Tropical, dry	> 20°C	< 1000 mm
TRM	Tropical, moist	> 20°C	1000 to 2000 mm
TRW	Tropical, wet	> 20°C	> 2000 mm
PBD	Polar/Boreal, Dry	< 0°C	PET > Annual Precip
PBW	Polar/Boreal, Wet	< 0°C	PET <= Annual Precip
---	---	---	---

Slope▼

1	Flat	Plat
2	Hilly	Collineux
3	Mountainous	Montagneux
	Unknown	Inconnu

Altitude▼

150	< 300 m	< 300 m
450	300-600 m	300-600 m
850	600-1100 m	600-1100 m
1200	>1100 m	>1100 m
	Unknown	Inconnu

E For the soil, Agropol needs absolutely (bold letters) that be selected one of the six options of **Soil (1)** (see combobox below) in order to assess, later on, the soil carbon content (IPCC, 2003a, b). But more precise information on the soil are more than welcomed, especially the following pieces which are in fact the minimum required for running biophysical models such as Epic:

- **Soils (2)** which lists names of soils according to WRB or USDA classification: 34 options in total, pre-filtered here by the "Soil (1)" option (see combobox below);
- **Texture**, with 6 options (see combobox below);
- **Stoniness**, with 3 options (see combobox below); if the exact percentage of stones is known, it can be keyboarded to replace the default value used for each option;
- **Depth** (to rock or impermeable layer), with 4 options (see combobox below); if the exact soil depth is known, it can be keyboarded (in centimetres only) to replace the default value used for each option.

Soil (1)▼

---	---	---
AQUI	Aquic	Ique
HCAM	High clay activity mineral	Minéraux argileux à forte activité
LCAM	Low clay activity mineral	Minéraux argileux à faible activité
SAND	Sandy	Sableux
SPOD	Spodic	Spodique
VOLC	Volcanic	Volcanique

Soil (2)▼

ALBE	Albeluvisol	WRB
ALIS	Alisol	WRB
CALC	Calcisol	WRB
CAMB	Cambisol	WRB
CHER	Chernozem	WRB
GYPS	Gypsisol	WRB
KAST	Kastanozem	WRB
LEPT	Leptosol	WRB
LUVI	Luvisol	WRB
PHAE	Phaeozem	WRB
REGO	Regosol	WRB
SOLO	Solonet	WRB
UMBR	Umbrisol	WRB
VERT	Vertisol	WRB
ARID	Aridisol	USDA
ALFI	Alfisol (high-base status)	USDA
INCE	Inceptisol	USDA
MOLL	Mollisol	USDA
VERT	Vertisol	USDA

Texture▼

1	Coarse (clay<18 % + sand>65%)	Grossier (argile<18 % + sable>65%)
2	Medium (18%<clay<35% + sand>15% OR clay<18% + 15%<sand< 65%)	Moyen (18%<argile<35% + sable>15% OU argile<18% + 15%<sable< 65%)
3	Medium fine (clay<35% + sand<15%)	Moyen fin (argile<35% + sable<15%)
4	Fine (35%<clay<60%)	Fin (35%<argile<60%)
5	Very fine (clay>60%)	Très fin (argile>60%)
6	Other	Autre
	Unknown	Inconnu

Stones▼

5	Low (stones < 10%)	Bas (pierres < 10%)
15	Medium (10-20% of stones)	Moyen (10-20% de pierres)
20	High (stones>20%)	Elevé (pierres > 20%)
	Unknown	Inconnu

Depth▼

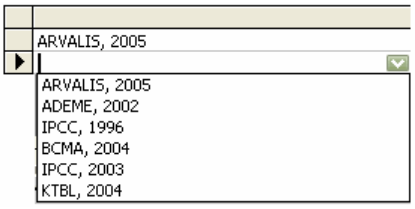
20	Shallow (< 40 cm)	Peu profond (< 40 cm)
60	Moderate (40-80 cm)	Modéré (40-80 cm)
100	Deep (80-120 cm)	Profond (80-120 cm)
140	Very deep (> 120 cm)	Très profond (> 120 cm)
	Unknown	Inconnu

F The **Human density**, or anthropization of the context (see combobox below, with 4 options), is also of key importance for analysing an agricultural activity and its outputs (availability of roads, electricity, labour, credit, inputs, markets, etc.), beside **Farm size**, which varies enormously from a world region to another: a farmer cultivating 20 hectares is usually considered as a big/rich farmer in India while it is a small/poor one in Brazil. For forestry, this Farm size is the size of the plantation, while for agriculture, it is the area not occupied by forests and unproductive lands (roads, constructions, canals, etc.). The **unit of area** chosen in the last combobox (5 options, see supra “General remarks”) is important since all other Agropol screens will use this unit as the default unit of area for the context.

Human density▼

1	'Natural' space	Espace 'naturel'
2	Low density	Densité faible
3	Medium density	Densité moyenne
4	High density, Peri-urban	Densité élévée, Péri-urbain

G In this table for **Biblio references** must be mentioned all reference materials which have been used (screen 03) or which will be used (following Agropol screens) for keyboarding some data or any other piece of information connected to the context. The options available by clicking in a cell of the table and the arrow on the right side(see below) are the ones listed in screen 02A. In case of mistake, a bibliographic reference can be eliminated from the table by selecting the entire line (click on the square with an arrow just before the reference) and using the “Delete” key of the keyboard.

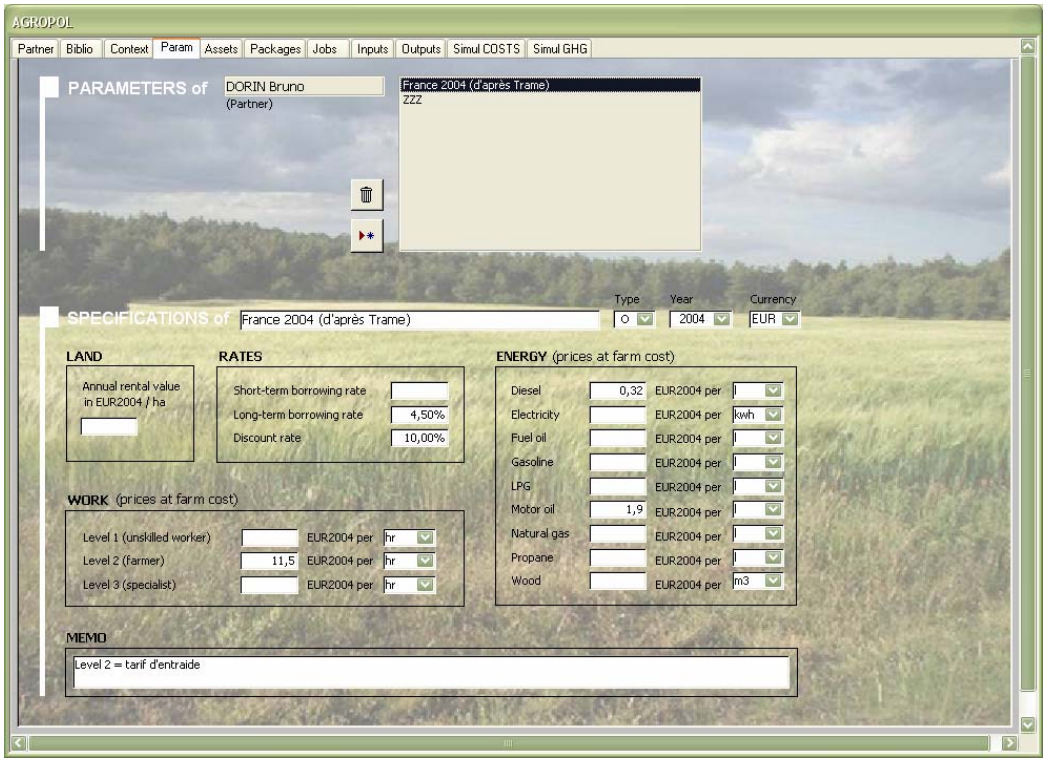


AGROPOL screen 04 — PARAM

Aims

Profitability of agricultural and forestry activities is relative for numerous reasons, among which are the following ones: (1) within a country, costs and margins vary from a year to another due to fluctuant prices of inputs and outputs; (2) between countries or continents, opportunity costs of factors (land, capital, labour…) are different due to complex historical processes (population growth and level of welfare, government's or multinationals' policies, taxes or subsidies for social or environmental concerns, etc.); (3) methods for calculating costs and margins vary also from a place to another, and differences observed may sometimes just be explained by a difference of terminology and/or computation. In order to bypass as far as possible these limits for comparing costs and margins of agro-technologies beyond the time and space conditions of their economical measurement, this screen 04 captures some parameters which will be used later on to compute either "real" costs (i.e. costs with some known local annual prices/rates) or "virtual" costs (i.e. costs for comparisons or scenarios purposes). In other words, the Agropol Partner has here the opportunity to keyboard not only a set of "observed" parameters, but also other sets of parameters in order to test, for example, how a price increase in labour or in fuels will impact the total cost of a technical package.

Visual aspect and screen sections



Details

A The **Partner name** (locked cell) is automatically filled in according to the selection made on screen 01A,

B …and the **sets of parameters** (locked cells) already keyboarded by this partner are listed on the right side, in alphabetic order. A click on one of these set displays its details on the underneath (screen 04C/D), and emulates also the hyperlink "Param" of screen 05B. Elements of this list can deleted (with restrictions) or enlarged (see buttons/icons on the left side).

C The **Name of a set of parameters** is keyboarded here in any language, the only restriction being that the text does not exceed 50 characters including blank spaces. This text starts usually with a name of a country, followed by a year (past or coming) and any other useful information which will help the Partner to select later on the set of parameters he/she wants without coming back to this screen 04. On the right side of this text space are the 3 following comboboxes:
- **Type**, with 2 options (see combobox below);
- **Year** (from 1900 to 2050) and **Currency** (see supra combox in "General remarks") which are automatically pasted (e.g. "EURO2004") for being mentioned in many legends on the underneath (screen 04D)

Type▼

O	observed values for the year mentioned	valeurs observées à l'année indiquée
T	test values (scenario, prospective, etc.)	valeurs test (scénario, prospective, etc.)

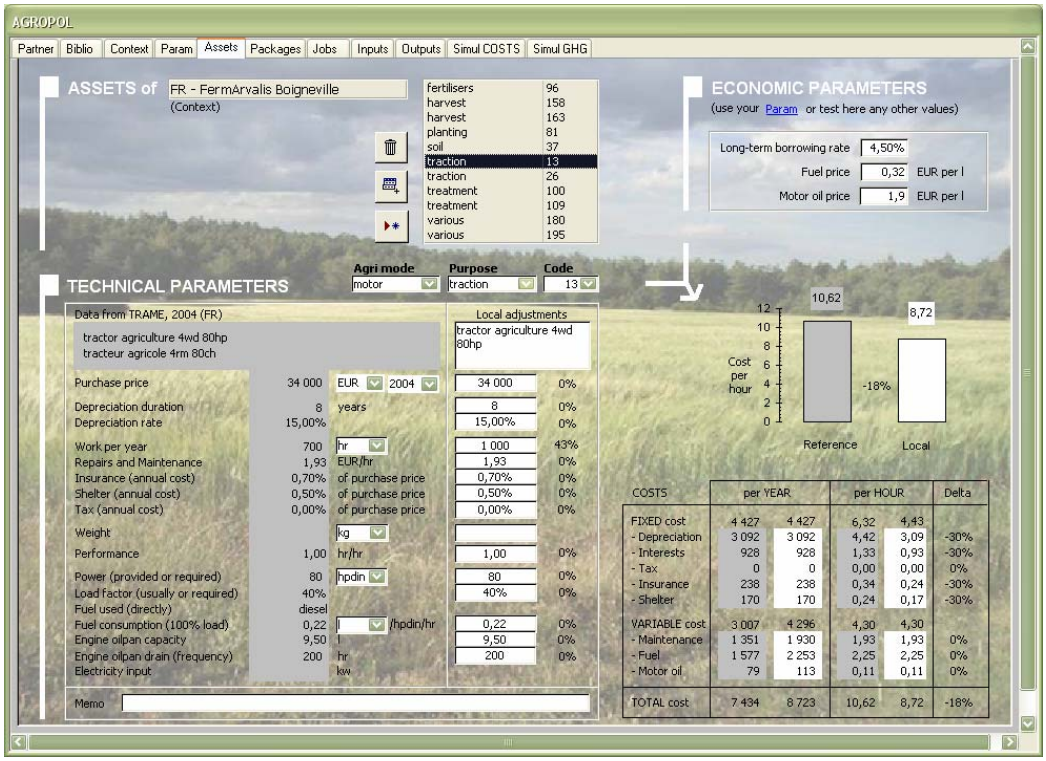
D In this section are keyboarded (or displayed) some parameters gathered into 4 subsections:
- **Land**, with 1 cell: the annual rental value per unit of area selected in screen 03F;
- **Rates**, with 3 cells: Short-term borrowing rate (i.e. for loans not exceeding one year), Long-term borrowing rate (i.e. for loans above 1 year), and Discount rate (for activities running over several years).
- **Work**, with 3 levels of price at farm costs, successively for unskilled workers, farmers and specialists;
- **Energy**, with 9 options in the current version; the presentation of this subsection will change in future Agropol versions: the list of options will be increased but not all displayed (an extendable table with comboboxes will enable to select and display only fuels used), as well as extend to technical parameters (greenhouse gas emissions per unit) currently displayed for possible adjustments on screens 08G and 08H.

AGROPOL screen 05 — ASSETS

Aims

Agricultural and forestry activities use various tools and means of traction/propulsion which are more or less capital intensive, more or less efficient for boosting land and human-work productivities, and more or less intensive in energy requirement (from feed for draught animals to fuel for four-wheel tractors or combine harvesters). Because these "assets" impact both costs and productivities, they are key factors for which this screen 05 is entirely dedicated. Its aim is to list and describe assets which are available in a "context" (screen 03) and which will be used later on for describing some "Jobs" (screen 07) and, then, for computing their costs (screen 10) as well as their greenhouse gas emissions (screen 11 under construction). Compared with other engineering models concerned about these aspects, Agropol's original feature is to offer a pre-recorded list of assets in order to save time, especially for those who have no or little technical knowledge on agricultural implements. This list is of course unfinished, and will be improved in future Agropol's versions, especially for developing countries, as well as for special assets (cars, trucks, water pump…) for which data are not yet available (database most welcomed).

Visual aspect and screen sections



Details

A The **context name** (cell automatically filled in) is the one selected in screen 03B. If no context is selected in screen 03B, the entire screen 05 is not emulated (grey screen).
The **list of assets** (list automatically filled in, on the right side of the context name) indicates all the assets already reported for the context, thought the mention of their purpose (asset for fertilizer application, or for harvest, or for traction…: see infra) and of their code (96, 158, 163…: see infra). Members of this list can be deleted, duplicated or increased (with buttons/icons on the left side). Selection of one of them leads also to show its details on screen 05B/C.

B Only one option for **Agri mode** (1st combox) is at present available: "motor" for [motorized agriculture – *agriculture motorisée*]. But future Agropol versions concerned about developing countries will include [agriculture with draught animal – *agriculture avec traction animale*] and [manual agriculture – *agriculture manuelle*] in order to pre-select a list of assets specific to these types of agricultural production.
The aim of **Purpose** (2nd combobox, with 8 possible options: see below) is to filter as far as possible the **Code** options (3rd combobox: see below): 220 in the current version of Agropol (BCMA, 2004).

Purpose ▼	
fertilisers	engrais chimique
harvest	récolte
manure	fumure organique
planting	plantation
soil	sol
traction	traction
treatment	traitement
various	divers

Code ▼		
1	track-layer 60hp	chenillard 60ch
2	tractor step over 70hp	enjambeur 70ch
3	tractor agriculture 2wd 40hp	tracteur agricole 2rm 40ch
4	tractor agriculture 2wd 50hp	tracteur agricole 2rm 50ch
5	tractor agriculture 2wd 60hp	tracteur agricole 2rm 60ch
6	tractor agriculture 2wd 70hp	tracteur agricole 2rm 70ch
7	tractor agriculture 2wd 80hp	tracteur agricole 2rm 80ch
8	tractor agriculture 2wd 90hp	tracteur agricole 2rm 90ch
9	tractor agriculture 2wd 100hp	tracteur agricole 2rm 100ch
10	tractor agriculture 4wd 50hp	tracteur agricole 4rm 50ch
11	tractor agriculture 4wd 60hp	tracteur agricole 4rm 60 cv
12	tractor agriculture 4wd 70hp	tracteur agricole 4rm 70ch
13	tractor agriculture 4wd 80hp	tracteur agricole 4rm 80ch
14	tractor agriculture 4wd 90hp	tracteur agricole 4rm 90 cv

	C	When a code of asset is chosen (see above), details of the asset (according to a source of data mentioned on the first line) are immediately listed on a grey tinted area (locked cells), as well as copied on the right side (white colour area, modifiable cells) for local adjustments (price, depreciation duration, etc.): if changes occurred, difference between original values and local values are mentioned in percentage in order to quickly identify where such changes took place (in the above example, we have only changed one value, the "work per year", from 700 hours to 1000 hours, i.e. an increase of 43%). This screen 05C is rather sophisticated for several reasons, among which are the following ones: (1) an asset can be "self-propelled", or not: in this later case, the 5th last lines (from "Fuel used" to "Electricity input") are not visible (note: "electricity input" is not yet operational in the current version); (2) values for asset performance are stated in various kinds of unit (unit of time as in the above example, or unit of area, or unit of outputs such as bales of straw…) which has complicated many calculations; (3) all values in this screen can be converted into other units than the original ones (from "hectare" to "acre" for example), including currency units (27 possible options in the current version) and their year (1948 to 2005 in the current version), which has also led to complicate some computations.
	D	Before showing the per hour costs of each asset (screen 05E), some economic parameters must be filled in, either by pasting the parameters selected on screen 04B thanks to a simple click on the hyperlink **Param**, or by typing any other values: nothing here (screen 05D) will be recorded and used for later computations. Only a special attention must be paid on the units of quantity/volume which must be the same between screens 05D and screen 04B.
	E	When technical and economic parameters are well-informed, the per-hour **cost** with original values (grey colour area, locked cells) and with local adjustments (white colour area, locked cells) are summarised in a bar chart, and detailed in a the table on the underneath, along with annual costs. The column **Delta** shows the percentage difference between original and local per-hour costs.

AGROPOL screen 06 — PACKAGES

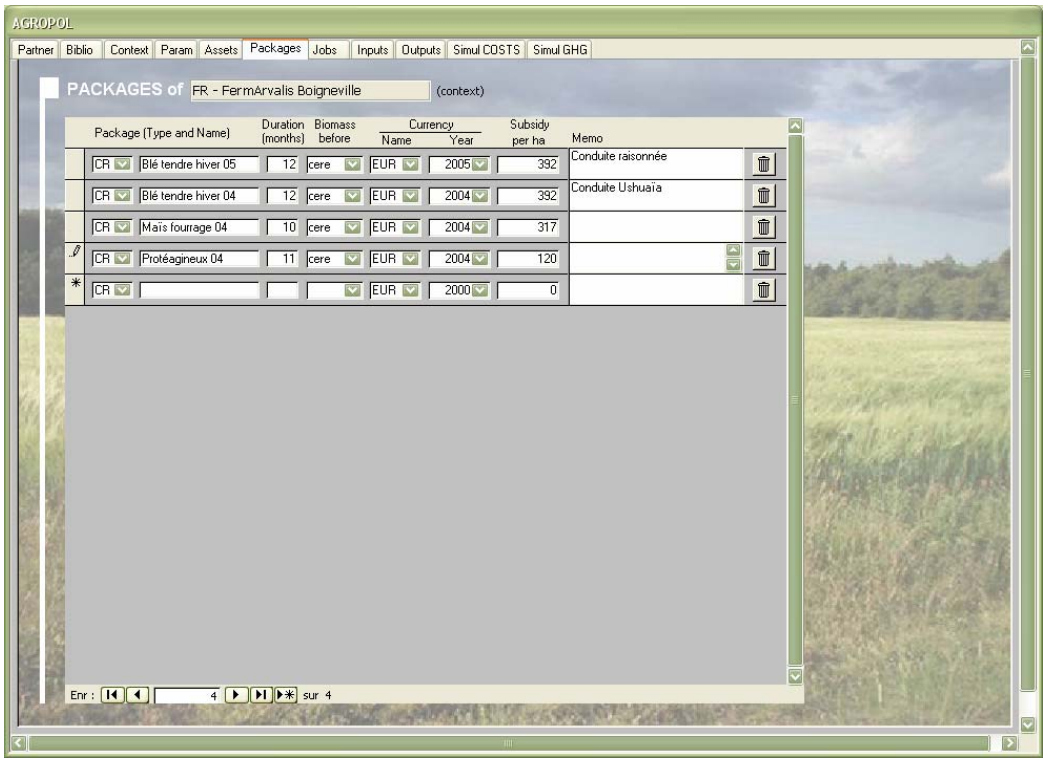
Aims

Agropol is entirely dedicated to the description and analyse of agricultural/forestry production techniques which mobilize various factors (land, capital, labour, inputs…) for a wide range of outputs (food, feed, bio-energy, social and environmental externalities…). These techniques can be considered and delimited as sequences of human, animal and/or mechanical "Jobs" (see next screen 07), sequences called "Packages" in Agropol. The aim of this screen 06 is simply to characterize the "Packages" which will be detailed in the 3 following Agropol screens ("Jobs", "Inputs" and "Outputs"). In other words, compared to other engineering models, Agropol's big original feature is to ask first what will be the sequence of technologies described, and not what will be the main output produced. This approach add lot of flexibility for describing and/or analysing a variety of agro-systems, especially the complex ones (mixed crops, agro-forestry, etc.) which are not today ranked among modern production systems despite numerous advantages that Agropol may also help to better identify and quantify.

Visual aspect and screen sections

A

B



Details

A The **context name** (locked cell automatically filled in) is the one selected in screen 03B. If no context is selected in screen 03B, the entire screen 06 is not emulated (grey screen). As soon as a Context is selected, the packages already reported for that Context are listed in the table on the underneath (screen 06B).

B In this extendable table where each lines can be deleted (with restrictions) after keyboarding (see button/icon on the right side), each package is characterized thought, successively:
- its **Type** (see comboxbox below): single crop, mixed crops, rotation of crops, etc.
- its **Name**, which can be in any language, the only restriction being that the text does not exceed 25 characters including blank spaces; this text may mention the species, the season, the year(s) or any other useful information which will help the Partner to easily identify later on the package he/she wants to select without coming back to this screen 06;
- its **Duration**, which can range from several months to several decades in the case of plantations;
- its **Biomass before**, with 9 options (see combobox below): an important information especially for bio-physical models, or for future Agropol versions which will assess the increase or decrease of soil carbon after a land-use change (IPCC, 2003b);
- the **Currency name** and the **Currency year** which will be used to give a monetary value to costs and sales;
- the (annual) **Subsidy per unit of area** (screen 03F), if any.

Type of package▼

CR	single crop	culture unique
MI	mixed crops	cultures associées
RO	rotation of crops	rotation de cultures
PA	pasture	pâture
AF	agroforestry	agroforestrie
PL	plantations	plantations

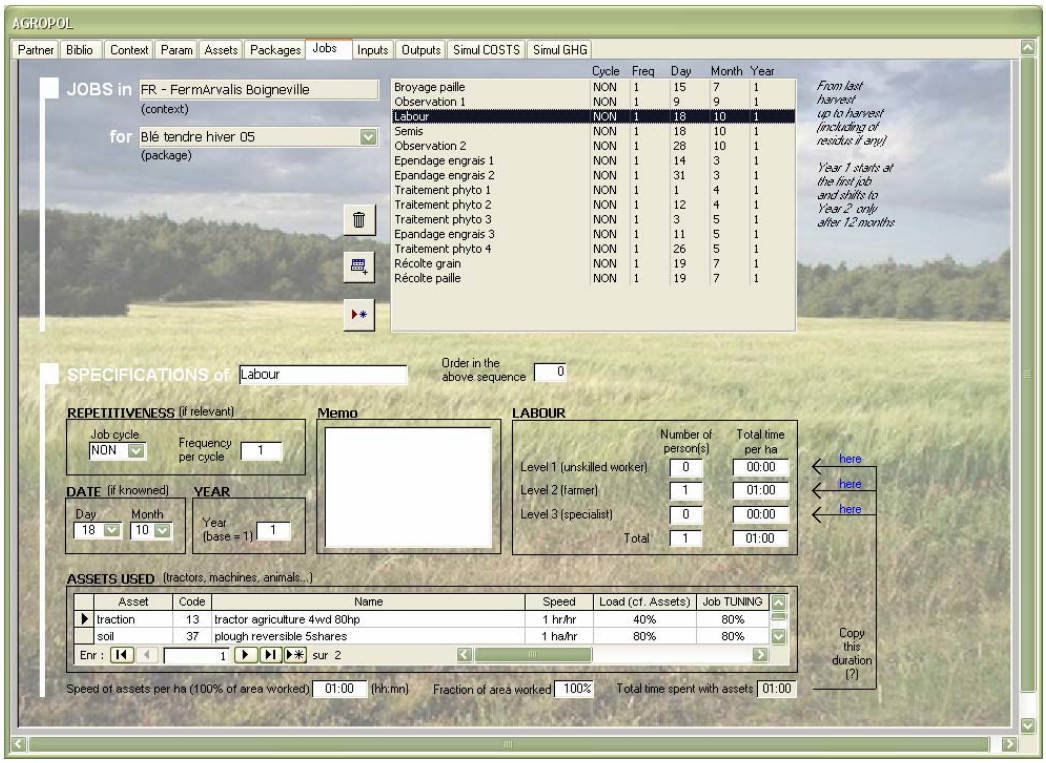
Biomass before▼

cere	annual cereal	céréale annuelle
gram	annual gramineae (cereal excl.)	graminée annuelle (céréale excl.)
olea	annual oleaginous crop (leguminous excl.)	oléagnineux annuel (légumineuse excl.)
legu	annual leguminous crop	légumineuse annuelle
annu	annual crop (other : cotton, beet, vegetable, spice...)	culture annuelle (autre : coton, betterave, légume, épice...)
herb	grassland	prairie
sava	fallow, savanna	jachère, savane
pere	perennial crop (forestry excl.)	culture pérenne (sylviculture excl.)
fore	forest, energy plantation	forêt, plantation énergétique
xxxx	(other)	(autre)
yyyy	(unknown)	(inconnu)

Aims

In Agropol, a “Package” is defined as a sequence of human, animal and/or mechanical “Jobs” (see supra, screen 06) which minimum duration starts from the harvest of the last crop/plantation, and ends when is harvested all biomasses taken out of the land (i.e. including residues if the latter are not left on the spot for various purposes: animal grazing, soil protection or regeneration, etc.). Farm post-harvest jobs, like the drying of grains, can be added if any. Whereas all these jobs and their duration are keyboarded in this screen 07, the inputs applied during these jobs, as well as the outputs obtained from these jobs, are successively keyboarded on screen 08 and on screen 09.

Visual aspect and screen sections



A B C D E F

A The **Context name** (locked cell automatically filled in) is the one selected in screen 03B. If no context is selected in screen 03B, this entire screen 07 is not emulated (grey screen). When a Context is displayed, the Agropol user must choose, in the combobox on the underneath, one of the **Package** he/she has already declared in screen 06,

B …and the **list of jobs** (list automatically filled in, on the right side of the package name) immediately indicates, if any, all the jobs already reported, thought the mention of their name, their cycle, their frequency and their date (day, month and year). Members of this list can be deleted (with restrictions), duplicated (with restrictions) or increased (see buttons/icons on the left side). A click of one of these jobs leads to show its details on screen 07C/D/E/F.

C The **Name of the job** is keyboarded here in any language, the only restriction being that the text does not exceed 25 characters including blank spaces. Usually, jobs are keyboarded in their order of appearance, but in case one of them is forgotten during the process, its correct **Order in the above sequence** (screen 07B) must be adjust by mentioning, for each job, in the cell on the right side of the Job name, its number in the sequence of jobs.

D The description of a job stats with its **Repetitiveness**, i.e. its **Cycle** (see combobox below, with 5 options: daily, weekly, etc.) and the **Frequency** in the cycle (e.g. “2” for “twice a day” if “DAY” has been selected before). This information must in fact only be keyboarded, if required, for packages lasting more than 1 year, or for breeding activities, which are not yet possible to describe and analyse in the current Agropol version. In other words, for an annual crop, Cycle and Frequency must be left on their default value, respectively “NON” and “1”.

Job cycle▼

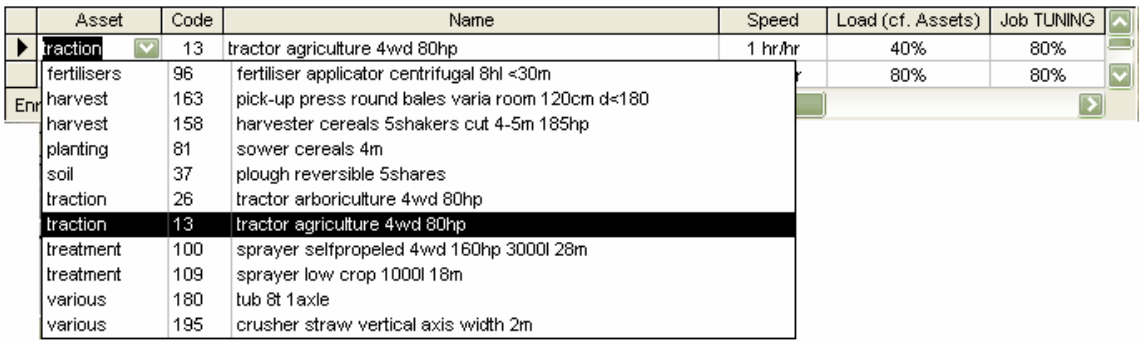
NON	none (occasional)	aucun (occasionnel)
DAY	daily	journalier
WEE	weekly	hebdomadaire
MON	monthly	mensuel
ANN	every year (only for package duration > 24 months)	chaque année (uniquement pour durée de paquet > 24 mois)

The **Day** (combobox of 31 options, from 1 to 31) and the **Month** (combobox of 12 options, from January to December) of the job must then be mentioned as far as possible (information especially useful for bio-physical model), along with the **Year** number: for an annual crop, it must always be 1 (the default value). In next Agropol versions, this year number will be used to discount accordingly all cost values associated to the concerned job.

Details

E In the section for **Labour**, the **Number of persons** involved in each job, as well as the **Total time** spent for each job (in hr:mn) per unit of area (screen 03F), must be keyboarded for each levels of remuneration: unskilled worker, farmer and specialist (screen 04D). After the keyboarding, the total of each column (number and time) is automatically done by Agropol (locked cells) for checking purposes.

F In this last section (extendable table), **Assets used** during the job are selected one by one by a click in the cell of the column “Asset” which displays a combobox (see below) listing all assets available in the Context (screen 05). When one of these assets is selected, its **Code** is automatically filled in (locked cell), as well as its **Name** (default name or name given by the Partner if any) (locked cell), its **Speed** (locked cell), and the **Load** factor which is mentioned twice, first in a locked cell, and then in a modifiable cell for **Job Tunin**g if it is of course required, but as it is the case in our example: the job named “Labour” (“Tillage” in English) use a plough which required a load of 80%, whereas the default load factor of the tractor is 40%: the latter percentage must be changed into 80% so that Agropol will be able to compute a double consumption of fuel for this specific work (tillage).



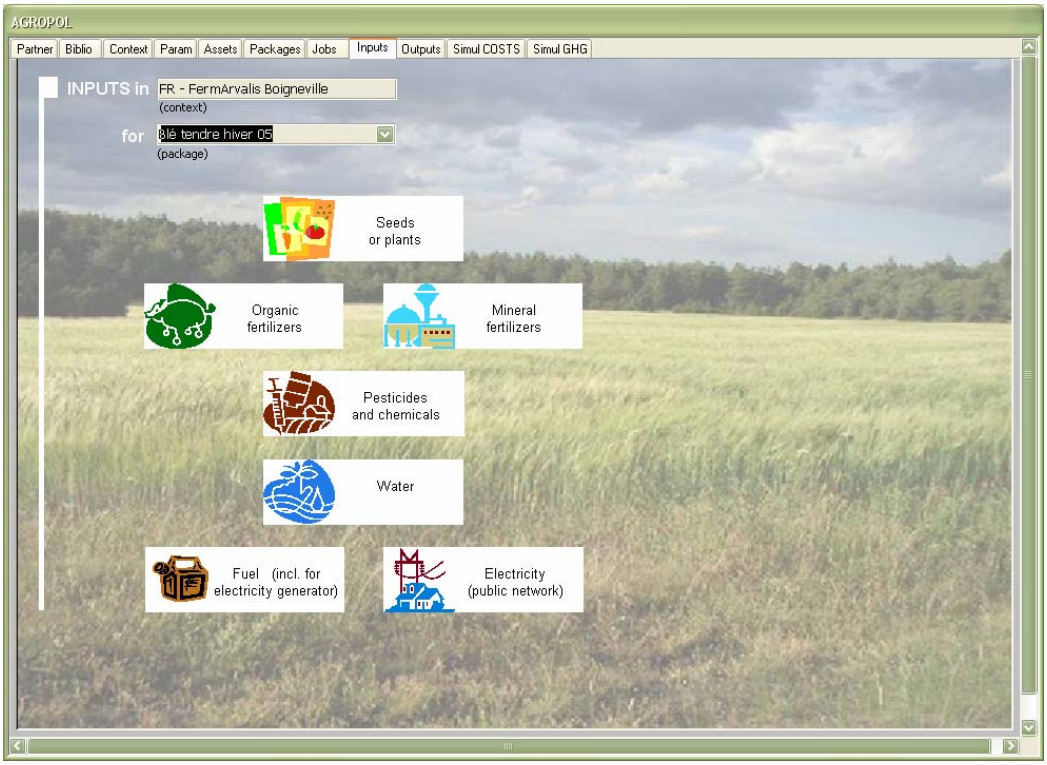
When all assets used for a job are keyboarded, Agropol computes whenever it is possible the **Speed of the asset** (fist cell below the table) per unit of area (screen 03F). If no or incorrect value is mentioned, a new one must be keyboarded here, along with the **Fraction of area worked** (default value = 100%, but some jobs may be only on some portions of the land) so that the **Total time spent with assets** (locked cell) is correctly assessed (Speed of asset * Fraction of area worked). With a click on the **hyperlinks “here”**, this total time can be paste/considered as the total time of a labour category (usually the farmer) is no more precise value is available.

AGROPOL screen 08 — INPUTS

Aims

Since the dawn of time, beside selected seeds or plants, farmers have applied inputs for maintaining and rising the land productivity (water, manure, etc.). Nowadays, these inputs may be used in massive quantities, and may also be produced by multinational industries like for pesticides and chemical fertilizers. The applications of “traditional” or “modern” inputs are fundamental components of a technical “Package” (screen 06), not only because they may be the only purpose of some human, animal and/or mechanical “Job” (screen 07), but also because they impact the yields, the costs as well as the ecosystem. The aim of this screen 08 is to keyboard the various inputs applied in a Package, through the mention of their type and cost, and as far as possible of their quantity, since these quantities are necessary for future Agropol version (assessment of greenhouse gases emissions and of some other environmental indicators), as well as for some other kinds of tools (biophysical models). Because all these data can hardly be keyboarded on a single screen, categories of inputs have been here mentioned in a rectangle along with an appropriate icon, rectangles on which a click with the mouse leads to open a specific window.

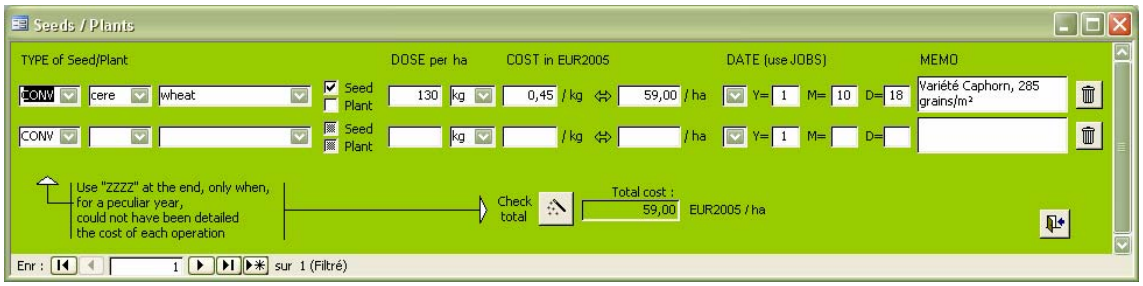
Visual aspect and screen sections



Details

A The **Context name** (locked cell automatically filled in) is the one selected in screen 03B. If no context is selected in screen 03B, this entire screen 08 is not emulated (grey screen). When a Context is displayed, the Agropol user must then choose, in the combobox on the underneath, one of the **Package** he/she has already declared on screen 06.

B A click on the rectangle entitled “**Seeds or plants**” opens the window below:



The **Type of Seed/Plant** is selected through 3 comboboxes (see below), listing successively:
- 3 possible origin (beside “other”, “unknown” and “special”),
- 9 groups of species,
- 165 common world species (with their English, French and Latin names) which choice is filtered through the option selected in the previous combobox (group of species).

CONV

FARM	farm seed/plant	semence/plant d'origine fermière
CONV	seed/plant certified by a public/private institution	semence/plant certifié par organisme public/privé
GEMO	GMO seed/plant	semence/plant OGM
xxxx	(other)	(autre)
yyyy	(unknown)	(inconnu)
zzzz	(special)	(spécial)

cere

cere	annual cereal	céréale annuelle
gram	annual gramineae (cereal excl.)	graminée annuelle (céréale excl.)
olea	annual oleaginous crop (leguminous excl.)	oléagnineux annuel (légumineuse excl.)
legu	annual leguminous crop	légumineuse annuelle
annu	annual crop (other : cotton, beet, vegetable, spice...)	culture annuelle (autre : coton, betterave, légume, épice...)
herb	grassland	prairie
sava	fallow, savanna	jachère, savane
pere	perennial crop (forestry excl.)	culture pérenne (sylviculture excl.)
fore	forest, energy plantation	forêt, plantation énergétique
xxxx	(other)	(autre)
yyyy	(unknown)	(inconnu)

wheat

(other cereal)	(autre céréale)	?	?
barley	orge	Poaceae	Hordeum
buckwheat	sarrasin	Polygonaceae	Fagopyrum
canary seed	alpiste	Poaceae	Avena
fonio	fonio	Poaceae	Digitaria
maize	maïs	Poaceae	Zea
millet	millet	Poaceae	Echinocloa, Eleusine, Eragrostis, P
oats	avoine	Poaceae	Avena
quinoa	quinoa	Chenopodiaceae	Chenopodium
rice, paddy	riz, paddy	Poaceae	Oryza
rye	seigle	Poaceae	Secale
sorghum	sorgho	Poaceae	Sorghum
triticale	triticale	Poaceae	Triticosecale
wheat	blé	Poaceae	Triticum

Then the **Dose** (per unit of area: screen 03F) and the **Costs** (per unit of currency: screen 06B) have to be keyboarded. The cost per unit of area must have a value like in all other windows for inputs, whereas here, the Dose and/or the unit Cost are not mandatory even if these values are strongly expected. Between these 3 cells (Dose + Unit cost + Cost per unit of area), when 2 of them are filled in, Agropol computes and displays the remaining one.

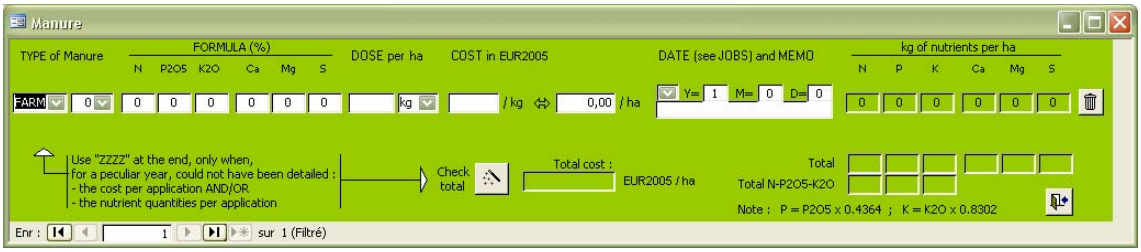
Before a Memo dedicated to any other useful information, the **Date** of sowing/planting (year, month and day) is automatically filled in after a click on the arrow and the selection, within the combobox which is displayed (see below), of the corresponding job. If no date is mentioned in the combobox, wheareas this date is known (at least the year and the month), the latter must absolutely be keyboarded in screen 07D, and not here.

Date▼

Year 1, Month 7, Day 15	Broyage paille
Year 1, Month 9, Day 9	Observation 1
Year 1, Month 10, Day 18	Labour
Year 1, Month 10, Day 18	Semis
Year 1, Month 10, Day 28	Observation 2
Year 1, Month 3, Day 14	Ependage engrais 1
Year 1, Month 3, Day 31	Epandage engrais 2
Year 1, Month 4, Day 1	Traitement phyto 1
Year 1, Month 4, Day 12	Traitement phyto 2
Year 1, Month 5, Day 3	Traitement phyto 3
Year 1, Month 5, Day 11	Epandage engrais 3
Year 1, Month 5, Day 26	Traitement phyto 4
Year 1, Month 7, Day 19	Récolte grain
Year 1, Month 7, Day 19	Récolte paille

If other materials are sown or planted, they can similarly be keyboarded in the next lines of the (extendable) table, and the **Total cost** per unit of area is gradually computed at the bottom of the window (locked cell). This total must be checked since it will be used and/or displayed as it is in other Agropol processes. And in case this total cost can unfortunately not be detailed by Jobs, there is a special procedure for bypassing this problem (see instructions on the screen itself and the example displayed infra in the pesticide window).

C A click on the rectangle entitled "**Organic fertilizers**" opens the window below:



The **Type of Manure** is selected through 2 comboboxes (see below), listing successively:
- 3 possible origin (beside "other", "unknown" and "special"),
- 14 organic fertilizers (beside "other" and "unknown") which choice is filtered through the option selected in the previous combobox (origin).

FARM

FARM	Animal faeces	Déjections animales
URBA	Urban/Domestic waste	Déchets urbains/domestiques
INDU	Material of industrial origin	Matière d'origine industrielle
xxxx	(other)	(autre)
yyyy	(unknown)	(inconnu)
zzzz	(special)	(spécial)

FARM 0

1	manure of cattle - stall housing	fumier bovin - stabulation entravée
2	manure of cattle - open housing	fumier bovin - stabulation libre
3	manure of horse	fumier équin
4	manure of sheep	fumier ovin
5	manure of goat	fumier caprin
6	manure of swine	fumier porcin
7	manure of poultry	fumier avicole
8	liquid manure - dilution by rainwater	lisier - dilution par eaux de pluie sur aire
9	liquid manure - dilution by water from milking room	lisier - dilution par eaux de salle de traite
10	(other)	(autre)
11	(unknown)	(inconnu)

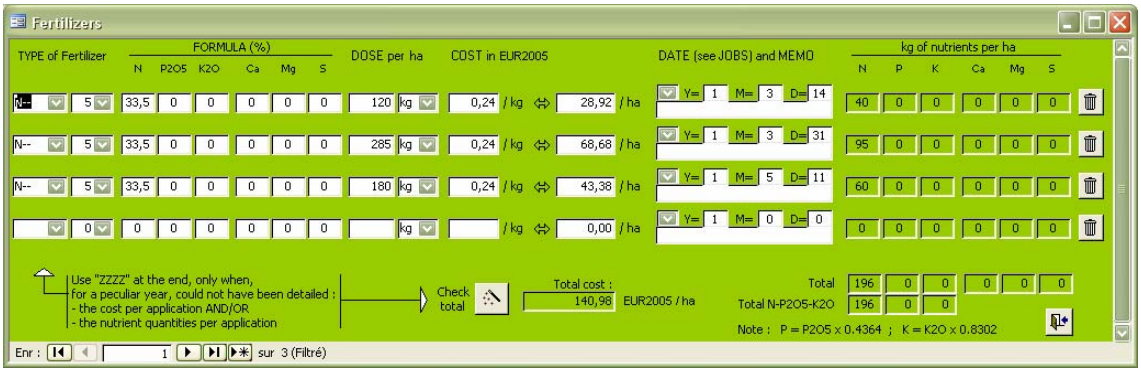
If one of the 14 organic fertilizers is selected, its **Formula** is immediately displayed on the right side for checking, or for corrections when the formula is more precisely known.

Then the **Dose** (per unit of area: screen 03F) and the **Costs** (per unit of currency: screen 06B) have to be keyboarded. The cost per unit of area must have a value like in all other windows for inputs, as also here the Dose and/or the unit Cost. Between these 3 cells (Dose + Unit cost + Cost per unit of area), when 2 of them are filled in, Agropol computes and displays the remaining one.

Above a Memo dedicated to any other useful information, the **Date** of the fertilizer application (year, month and day) is automatically filled in after a click on the arrow and the selection, within the combobox which is displayed (see combobox "Date" for Seeds/Plants), of the corresponding job. If no date is mentioned in the combobox, whereas this date is known (at least the year and the month), the latter must absolutely be keyboarded in screen 07D, and not here.

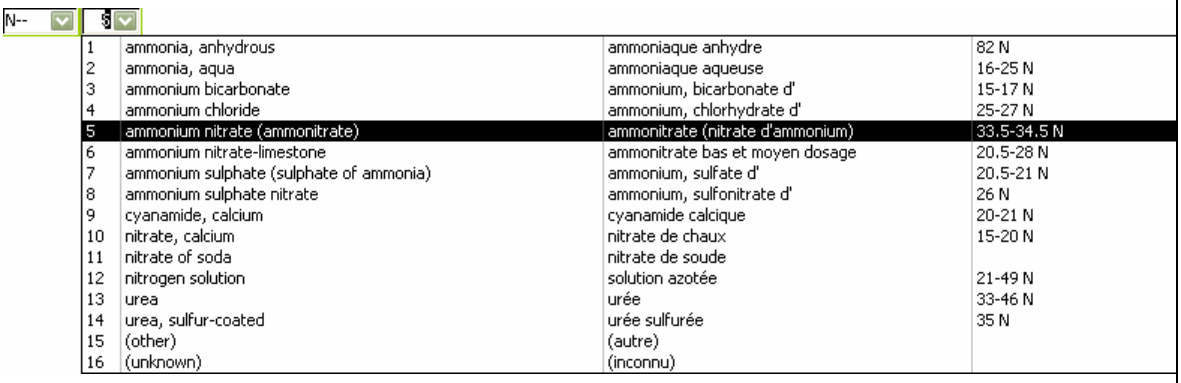
If other organic fertilizers are spread, they can similarly be keyboarded in the next lines of the (extendable) table, and the **Total cost** per unit of area is gradually computed at the bottom of the window (locked cell), along with the **Total nutrients** applied. These totals must be checked since they will be used and/or displayed as they are in other Agropol processes (NB: N quantities are especially important for computing N_2O emissions). And in case this total cost or total nutrients can unfortunately not be detailed by Jobs, there is a special procedure for bypassing this problem (see instructions on the screen itself and the example displayed infra in the pesticide window).

D A click on the rectangle entitled "**Mineral fertilizers**" opens the window below:



The **Type of Fertilizer** is selected through 2 comboboxes (see below), listing successively:
- 7 groups of mineral fertilizers (beside "other", "unknown" and "special"),
- 36 mineral fertilizers (beside "other" and "unknown") which choice is filtered through the option selected in the previous combobox (group).

N--	nitrogen fertilizer	engrais azoté
-P-	phosphorus fertilizer	engrais phosphorique
--K	potassium fertilizer	engrais potassique
NP-	NP fertilizer	engrais NP
N-K	NK fertilizer	engrais NK
-PK	KP fertilizer	engrais KP
NPK	NPK fertilizer	engrais NPK
xxxx	(other)	(autre)
yyyy	(unknown)	(inconnu)
zzzz	(special)	(spécial)



1	ammonia, anhydrous	ammoniaque anhydre	82 N
2	ammonia, aqua	ammoniaque aqueuse	16-25 N
3	ammonium bicarbonate	ammonium, bicarbonate d'	15-17 N
4	ammonium chloride	ammonium, chlorhydrate d'	25-27 N
5	ammonium nitrate (ammonitrate)	ammonitrate (nitrate d'ammonium)	33.5-34.5 N
6	ammonium nitrate-limestone	ammonitrate bas et moyen dosage	20.5-28 N
7	ammonium sulphate (sulphate of ammonia)	ammonium, sulfate d'	20.5-21 N
8	ammonium sulphate nitrate	ammonium, sulfonitrate d'	26 N
9	cyanamide, calcium	cyanamide calcique	20-21 N
10	nitrate, calcium	nitrate de chaux	15-20 N
11	nitrate of soda	nitrate de soude	
12	nitrogen solution	solution azotée	21-49 N
13	urea	urée	33-46 N
14	urea, sulfur-coated	urée sulfurée	35 N
15	(other)	(autre)	
16	(unknown)	(inconnu)	

If one of the 36 mineral fertilizers is selected, its **Formula** is immediately displayed on the right side for checking, or for corrections when the formula is more precisely known.

Then the **Dose** (per unit of area: screen 03F) and the **Costs** (per unit of currency: screen 06B) have to be keyboarded. The cost per unit of area must have a value like in all other windows for inputs, as also here the Dose and/or the unit Cost. Between these 3 cells (Dose + Unit cost + Cost per unit of area), when 2 of them are filled in, Agropol computes and displays the remaining one.

Above a Memo dedicated to any other useful information, the **Date** of the fertilizer application (year, month and day) is automatically filled in after a click on the arrow and the selection, within the combobox which is displayed (see combobox "Date" for Seeds/Plants), of the corresponding job. If no date is mentioned in the combobox, whereas this date is known (at least the year and the month), the latter must absolutely be keyboarded in screen 07D, and not here.

If other mineral fertilizers are spread, they can similarly be keyboarded in the next lines of the (extendable) table, and the **Total cost** per unit of area is gradually computed at the bottom of the window (locked cell), along with the **Total nutrients** applied. These totals must be checked since they will be used and/or displayed as they are in other Agropol processes (NB: N quantities are especially important for computing N_2O emissions). And in case this total cost or total nutrients can unfortunately not be detailed by Jobs, there is a special procedure for bypassing this problem (see instructions on the screen itself and the example displayed infra in the pesticide window).

E A click on the rectangle entitled "**Pesticides and chemicals**" opens the window below:

The **Type of Pesticides** is selected through 2 comboboxes (see below), listing successively:
- 7 groups of pesticides (beside "other", "unknown" and "special"),
- 6345 pesticides (beside "other" and "unknown") which choice is filtered through the option selected in the previous combobox (group); if one of these 6345 pesticide is selected, available information on its **Toxicity** is immediately displayed on the right side of the window.

HER1

HER1	herbicide	herbicide
HER2	herbicide safener	protection contre herbicide
HER3	algaecide	algicide (anti-algue)
HER4	plant growth regulator	régulateur de croissance de plante
HER5	defoliant	défoliant
HER6	desiccant	dessiccatif
INS1	insecticide	insecticide
INS2	insect growth regulator	régulateur de croissance d'insecte
INS3	repellent - insect	répulsif - insecte
INS4	pheromone	phéromone
INS5	synergist	synergiste
MIC1	fungicide	fongicide
MIC2	viruscide	viruscide (anti-virus)
MIC3	microbiocide	microbiocide
MIC4	wood preservative	conservateur de bois
GAS1	fumigant	fumigène
GAS2	propellant	propulseur
NEM1	nematicide	nématicide
AVI1	avicide	avicide (anti-oiseau)
AVI2	repellent - bird	répulsif - oiseau
MAM1	rodenticide	rodenticide (anti-rongeur)
MAM2	repellent - rodent	répulsif - rongeur
MAM3	repellent - bear	répulsif - ours
MAM4	repellent - deer	répulsif - cerf, biche
MAM5	repellent - dog and cat	répulsif - chien ou chat
MOL1	molluscicide	molluscicide (anti-mollusque)
AQU1	piscicide	piscicide (anti-poisson)
AQU2	water treatment	traitement hydrothérapique (eau)
AQU3	antifoulant	anti-pourrissement
XX01	bait	appât
XX02	fragrance	parfum

HER1

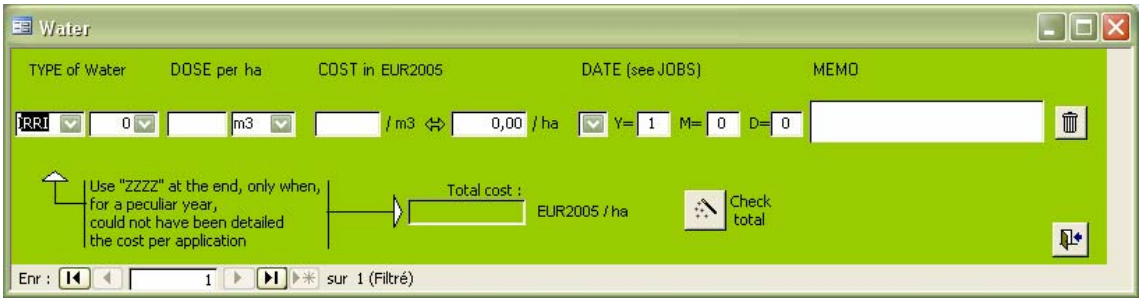
1	1,3-dibromo-5,5-dimethylhydantoin
2	1,3-dichloro-5,5-dimethylhydantoin
3	1,3-Dichloro-5-ethyl-5-methylhydantoin
4	1-bromo-3-chloro-5,5-dimethyl hydantoin
5	1-Hydroxymethyl-5,5-dimethyl hydantoin
6	1-Octanol
7	1H-Pyrazole-3-carbonitrile, 5-amino-1-(2,6-dichloro-4-(trifluoromethyl)phenyl)-4-((trifluoromethyl)sulfinyl)-
8	2,3,6-TBA, dimethylamine salt
9	2,3,6-TBA, dimethylamine salt, other related

Then the **Dose** (per unit of area: screen 03F) and the **Costs** (per unit of currency: screen 06B) have to be keyboarded. The cost per unit of area must have a value like in all other windows for inputs, whereas here, the Dose and/or the unit Cost are not mandatory even if these values are welcomed.

Before a Memo dedicated to any other useful information, the **Date** of the pesticide application (year, month and day) is automatically filled in after a click on the arrow and the selection, within the combobox which is displayed (see combobox "Date" for Seeds/Plants), of the corresponding job. If no date is mentioned in the combobox, wheareas this date is known (at least the year and the month), the latter must absolutely be keyboarded in screen 07D, and not here.

If other pesticides are used, they can similarly be keyboarded in the next lines of the (extendable) table, and the **Total cost** per unit of area is gradually computed at the bottom of the window (locked cell). This total must be checked since it will be used and/or displayed as it is in other Agropol processes. And in case this total cost or total nutrients can unfortunately not be detailed by Jobs, there is a special procedure for bypassing this problem (see instructions on the screen itself and the result displayed above).

F A click on the rectangle entitled "**Water**" opens the window below:



The **Type of Water** is selected through 2 comboboxes (see below), listing successively:
- 3 kinds of water (beside "other", "unknown" and "special"),
- 4 types of irrigation (beside "other" and "unknown").

IRRI

PREC	rainwater	eau de pluie
IRRI	irrigation water	eau d'irrigation
DRIN	drinking water	eau de boisson
xxxx	(other)	(autre)
yyyy	(unknown)	(inconnu)
zzzz	(special)	(spécial)

IRRI 0

1	gravitational (embankments...)	gravitationnelle (digues...)
2	sprinkled - high pressure (cannons)	aspersion haute pression (canons)
3	sprinkled - low pressure (ramps, sprinklers)	aspersion basse pression (rampes, sprinklers)
4	drop by drop	goutte à goutte
5	(other)	(autre)
6	(unknown)	(inconnu)

Then the **Dose** (per unit of area: screen 03F) and the **Costs** (per unit of currency: screen 06B) have to be keyboarded. The cost per unit of area must have a value like in all other windows for inputs, whereas here, the Dose and/or the unit Cost are not mandatory even if these values are strongly expected. Between these 3 cells (Dose + Unit cost + Cost per unit of area), when 2 of them are filled in, Agropol computes and displays the remaining one.

Before a Memo dedicated to any other useful information, the **Date** of water use (year and month) is automatically filled in after a click on the arrow and the selection, within the combobox which is displayed (see combobox "Date" for Seeds/Plants), of the corresponding job. If no date is mentioned in the combobox, wheareas this date is known (at least the year), the latter must absolutely be keyboarded in screen 07D, and not here.

If other water is used, it can similarly be keyboarded in the next lines of the (extendable) table, and the **Total cost** per unit of area is gradually computed at the bottom of the window (locked cell). This total must be checked since it will be used and/or displayed as it is in other Agropol processes. And in case this total cost can unfortunately not be detailed by Jobs, there is a special procedure for bypassing this problem (see instructions on the screen itself and the example displayed supra in the pesticide window).

G A click on the rectangle entitled "**Fuel**" opens the window below, dedicated only to fuels which are not burnt by the assets (screen 05).

The **Type of Fuel** is selected through 2 comboboxes (see below), listing successively:
- 4 kinds of fuels (beside "other", "unknown" and "special"),
- 17 fuels (beside "other" and "unknown") which choice is filtered through the option selected in the previous combobox (kind of fuel); if one of the 17 fuels is selected, its **CO2 emission** is immediately displayed on the right side for checking, or for corrections when the emission is more precisely known; in future Agropol version, these later indications/parameters will be transferred to screen 04.

LIQU

SOLI	solid fossil	solide fossile
LIQU	liquid fossil	liquide fossile
GAZE	gaseous fossil	gaz fossile
BIOE	bio-fuel	bio-combustible
xxxx	(other)	(autre)
yyyy	(unknown)	(inconnu)
zzzz	(special)	(spécial)

LIQU

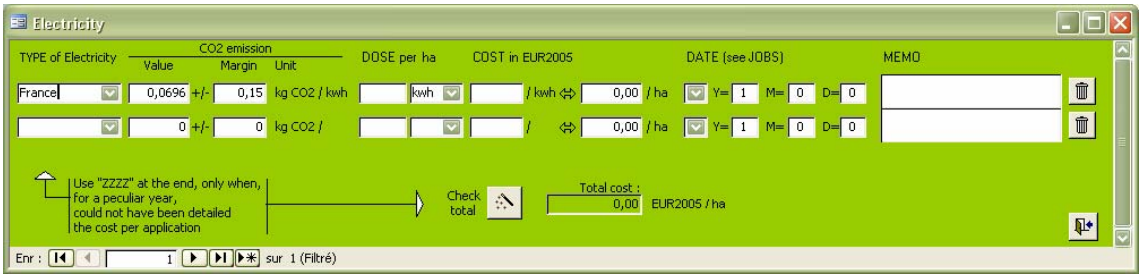
13	fuel oil, distillate (l)	fioul, distillat (l)
14	fuel oil, distillate (kwh)	fioul, distillat (kwh)
15	fuel oil, residual (l)	fioul, résiduel (l)
16	fuel oil, residual (kwh)	fioul, résiduel (kwh)
17	diesel (l)	diesel (l)
18	diesel (kwh)	diesel (kwh)
19	kerosene (l)	kérosène (l)
20	kerosene (kwh)	kérosène (kwh)
21	petrol (gasoline) (l)	essence (l)
22	petrol (gasoline) (kwh)	essence (kwh)
23	LPG (liquefied petrol gas) (l)	GPL (gaz de pétrole liquéfié) (l)
24	LPG (liquefied petrol gas) (kwh)	GPL (gaz de pétrole liquéfié) (kwh)
25	propane (l)	propane (l)
26	propane (kwh)	propane (kwh)
27	(other) (l)	(autre) (l)
28	(other) (kwh)	(autre) (kwh)
29	(unknown) (l)	(inconnu) (l)
30	(unknown) (kwh)	(inconnu) (kwh)

Then the **Dose** (per unit of area: screen 03F) and the **Costs** (per unit of currency: screen 06B) have to be keyboarded. The cost per unit of area must have a value like in all other windows for inputs, as also here the Dose and/or the unit Cost. Between these 3 cells (Dose + Unit cost + Cost per unit of area), when 2 of them are filled in, Agropol computes and displays the remaining one.

Before a Memo dedicated to any other useful information, the **Date** of the fuel burning (year and month at least) is automatically filled in after a click on the arrow and the selection, within the combobox which is displayed (see combobox "Date" for Seeds/Plants), of the corresponding job. If no date is mentioned in the combobox, wheareas this date is known (at least the year and the month), the latter must absolutely be keyboarded in screen 07D, and not here.

If other fuels are burnt, they can similarly be keyboarded in the next lines of the (extendable) table, and the **Total cost** per unit of area is gradually computed at the bottom of the window (locked cell). This total must be checked since it will be used and/or displayed as it is in other Agropol processes. And in case this total cost can unfortunately not be detailed by Jobs, there is a special procedure for bypassing this problem (see instructions on the screen itself and the example displayed supra in the pesticide window).

H A click on the rectangle entitled "**Electricity**" opens the window below, dedicated only to electricity which is not used by the assets (screen 05).



The **Type of Electricity** is selected through 1 combobox only (see below) of 1974 options, i.e. the electricity production profiles of 141 regions of the world (including the whole world itself) from 1988 to 2002 (http://www.ghgprotocol.org). If one of these 1974 options is selected, the **CO2 emission** per kilowatt-hour is immediately displayed on the right side for checking, or for corrections when the emission is more precisely known. In future Agropol version, these later indications/parameters will be transferred to screen 04.

Then the **Dose** (per unit of area: screen 03F) and the **Costs** (per unit of currency: screen 06B) have to be keyboarded. The cost per unit of area must have a value like in all other windows for inputs, as also here the Dose and/or the unit Cost. Between these 3 cells (Dose + Unit cost + Cost per unit of area), when 2 of them are filled in, Agropol computes and displays the remaining one.

Before a Memo dedicated to any other useful information, the **Date** of the electricity use (year and month at least) is automatically filled in after a click on the arrow and the selection, within the combobox which is displayed (see combobox "Date" for Seeds/Plants), of the corresponding job. If no date is mentioned in the combobox, wheareas this date is known (at least the year and the month), the latter must absolutely be keyboarded in screen 07D, and not here.

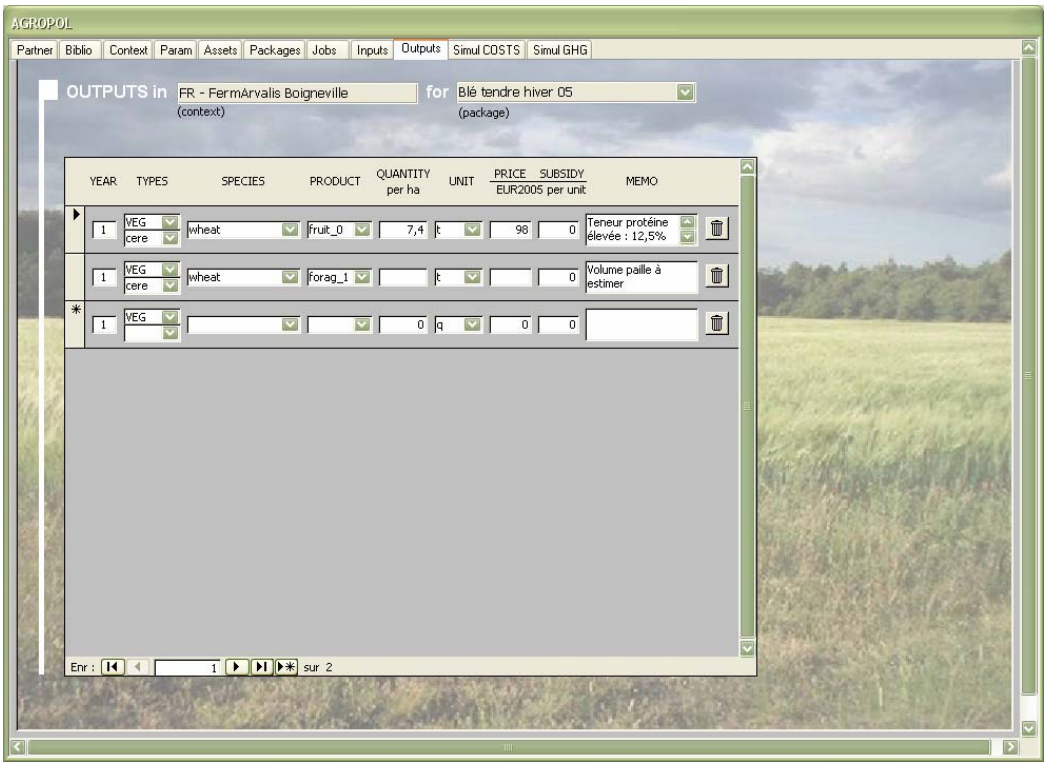
If other electricity is used, it can similarly be keyboarded in the next lines of the (extendable) table, and the **Total cost** per unit of area is gradually computed at the bottom of the window (locked cell). This total must be checked since it will be used and/or displayed as it is in other Agropol processes. And in case this total cost can unfortunately not be detailed by Jobs, there is a special procedure for bypassing this problem (see instructions on the screen itself and the example displayed supra in the pesticide window).

AGROPOL screen 09 — OUTPUTS

Aims

Agriculture and forestry are undoubtedly the activities which produce the most diverse physical outputs, beside their wide range of services in the fields of employment, environment, recreation, etc. The aim of this screen 09 is to capture only the physical outputs which are obtained from the field, after a sequence of Jobs (screen 07) and an application Inputs (screen 08) pertaining to a Package (screen 06).

Visual aspect and screen sections



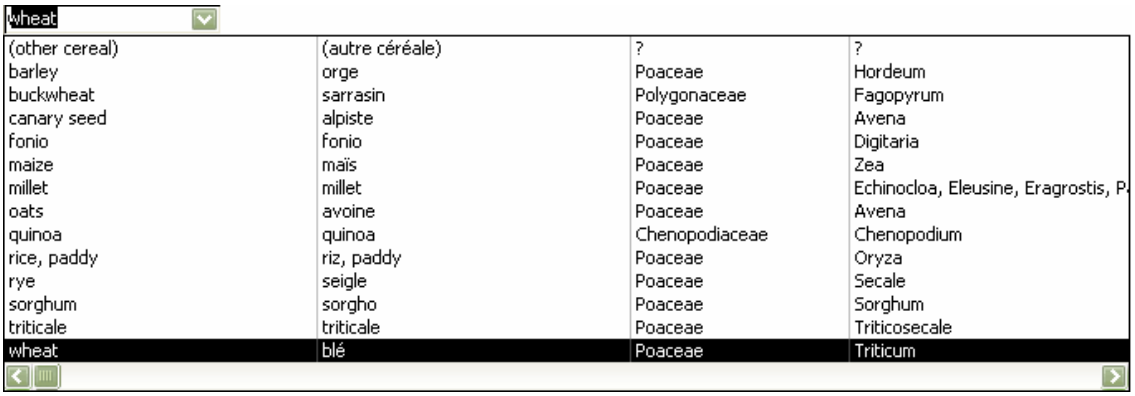
A The **Context name** (locked cell automatically filled in) is the one selected in screen 03B. If no Context is selected in screen 03B, this entire screen 09 is not emulated (grey screen). When a Context is displayed, the Agropol user must then choose, in the combobox on the right side, one of the **Package** he/she has already declared on screen 06. As soon as a Package is selected, the outputs already reported for that Package are listed in a table appearing on the underneath (screen 09B)

B For each **Year** of the Package (Year = 1 for annual crops) must be keyboarded in this table the different products obtained (grain of wheat and straw of wheat in our example). For each product (i.e. each line), the procedure involve the following 4 comboboxes:
- the two first ones under the column heading "**Types**" list successively the product kingdom (only 1 option in the current Agropol version: "Vegetal") and the product group with 9 options (see below);
- the third combobox under the column heading "**Species**" lists 165 common world species (with their English, French and Latin names: see below) which choice is filtered through the option selected in the previous combobox;
- the fourth and last combobox, under the column heading "**Products**", list 19 options of possible products from these species (see below).

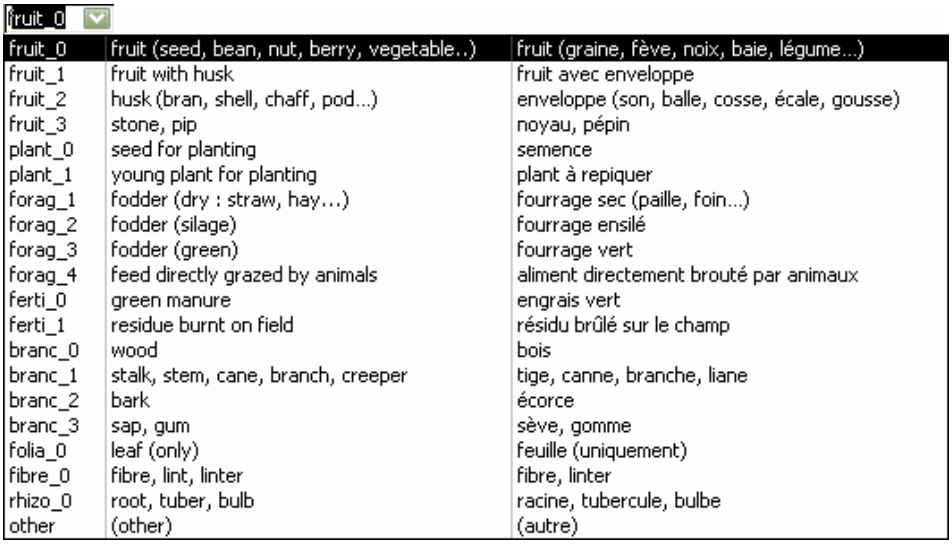
Details

cere

cere	annual cereal	céréale annuelle
gram	annual gramineae (cereal excl.)	graminée annuelle (céréale excl.)
olea	annual oleaginous crop (leguminous excl.)	oléagnineux annuel (légumineuse excl.)
legu	annual leguminous crop	légumineuse annuelle
annu	annual crop (other : cotton, beet, vegetable, spice...)	culture annuelle (autre : coton, betterave, légume, épice...)
herb	grassland	prairie
sava	fallow, savanna	jachère, savane
pere	perennial crop (forestry excl.)	culture pérenne (sylviculture excl.)
fore	forest, energy plantation	forêt, plantation énergétique
xxxx	(other)	(autre)
yyyy	(unknown)	(inconnu)



wheat			
(other cereal)	(autre céréale)	?	?
barley	orge	Poaceae	Hordeum
buckwheat	sarrasin	Polygonaceae	Fagopyrum
canary seed	alpiste	Poaceae	Avena
fonio	fonio	Poaceae	Digitaria
maize	maïs	Poaceae	Zea
millet	millet	Poaceae	Echinocloa, Eleusine, Eragrostis, P
oats	avoine	Poaceae	Avena
quinoa	quinoa	Chenopodiaceae	Chenopodium
rice, paddy	riz, paddy	Poaceae	Oryza
rye	seigle	Poaceae	Secale
sorghum	sorgho	Poaceae	Sorghum
triticale	triticale	Poaceae	Triticosecale
wheat	blé	Poaceae	Triticum



fruit_0	fruit (seed, bean, nut, berry, vegetable..)	fruit (graine, fève, noix, baie, légume...)
fruit_1	fruit with husk	fruit avec enveloppe
fruit_2	husk (bran, shell, chaff, pod...)	enveloppe (son, balle, cosse, écale, gousse)
fruit_3	stone, pip	noyau, pépin
plant_0	seed for planting	semence
plant_1	young plant for planting	plant à repiquer
forag_1	fodder (dry : straw, hay...)	fourrage sec (paille, foin...)
forag_2	fodder (silage)	fourrage ensilé
forag_3	fodder (green)	fourrage vert
forag_4	feed directly grazed by animals	aliment directement brouté par animaux
ferti_0	green manure	engrais vert
ferti_1	residue burnt on field	résidu brûlé sur le champ
branc_0	wood	bois
branc_1	stalk, stem, cane, branch, creeper	tige, canne, branche, liane
branc_2	bark	écorce
branc_3	sap, gum	sève, gomme
folia_0	leaf (only)	feuille (uniquement)
fibre_0	fibre, lint, linter	fibre, linter
rhizo_0	root, tuber, bulb	racine, tubercule, bulbe
other	(other)	(autre)

The **Quantity** obtained (per unit of area: screen 03F) is then keyboarded along with its unit **Price** (per unit of currency: screen 06B) and the **Subsidy** (per unit produced) if any.

At the end of each line stands a **Memo** for any useful information on the product (quality, destination, storage conditions, etc.).

AGROPOL screen 10 — SIMULCOSTS

Aims

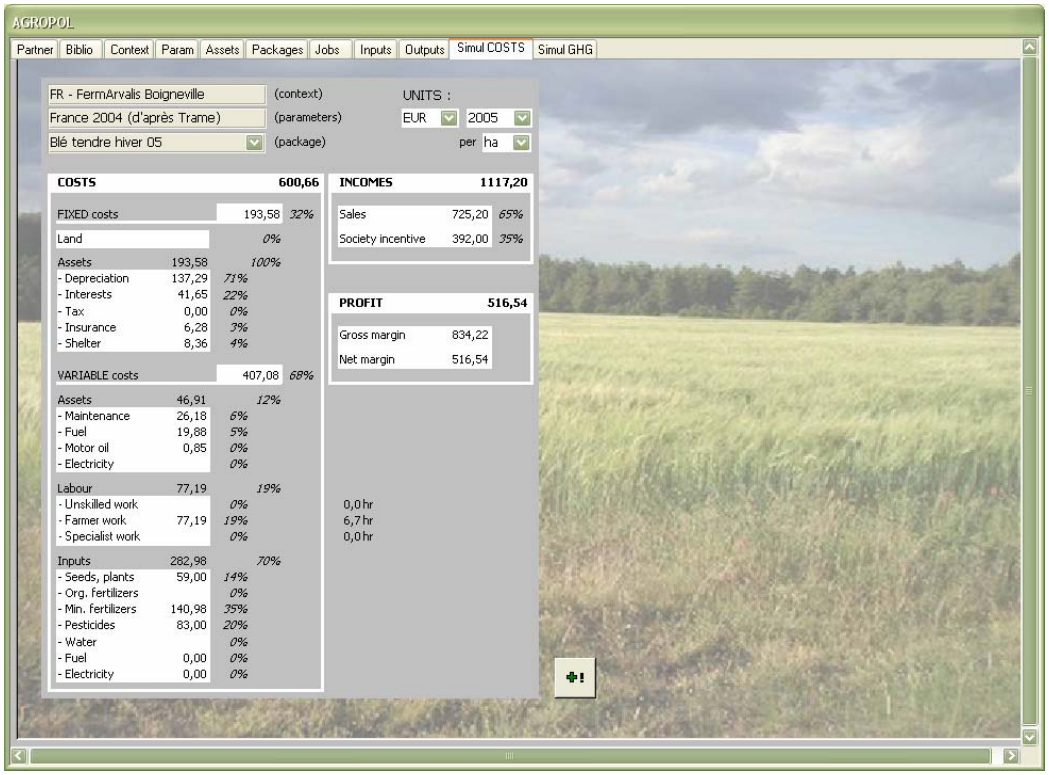
The first two objectives of Agripol were:
- to assess the fixed and variable costs of a sequence of technical operations which leads to produce, export and sell one or several biomass fractions from a piece of land, and to deduct the profit made from the specific investments in work, capital and inputs;
- to be able to quickly recalculate these costs and profits with moving parameters across time and/or space, i.e. other prices (of labour, of fuel or electricity, of water, of outputs, etc.) and other rates (borrowing rate, discount rate, etc.) than the ones pertaining to a specific context of time and space.

The result presented in this screen 10 is satisfactory and unique compared to other engineering models. But lot of space is still left for improvements, especially for fossil fuel prices: their change not only impacts the cost of their direct uses (as presently assed by Agropol), but also their indirect uses, in the manufacture of fertilizers for example.

Visual aspect and screen sections

A

B



C

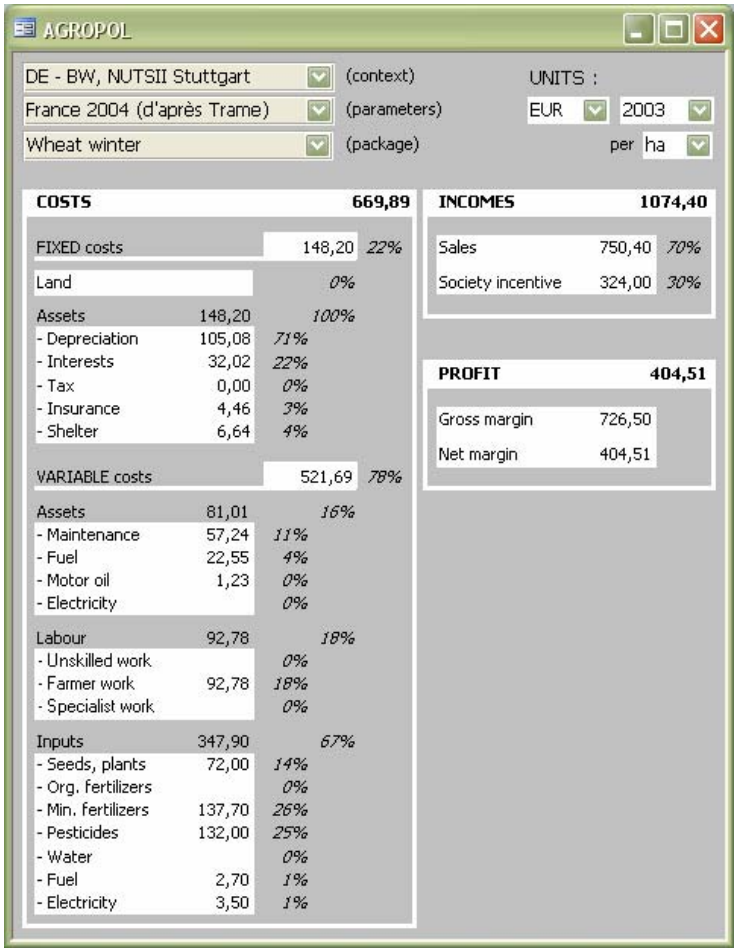
Details

A The **Context** (locked cell automatically filled in) is the one selected in screen 03B, and the **Param** (locked cell automatically filled in) is the set selected in screen 04B. If no Context or Param is previously selected, this entire screen 10 is not emulated (grey screen). When Context and Param are displayed, the Agropol user must select a **Package** in a combox. After this selection, the detailed costs and incomes are displayed in a table on the underneath (screen 10B) in the **Units** displayed on the right side, i.e.:
- the unit of currency used for the Package (screen 06B): this unit of currency can be changed (11 options of currency and 57 options of years in most cases: see supra “General remarks”) to display accordingly the different values mentioned in the table on the underneath;
- the unit of area chosen for the Context (screen 03F) which can also be modified (5 options) to convert the values on the underneath into another unit of area.

B The table (locked cells everywhere) is divided into 3 sections:
- the **Costs** section, which first displays the total cost in bold characters, and then its details, divided into **Fixed costs** and **Variables costs**. On the right side of each value is also displayed a percentage of the cost towards the immediate total or subtotal made on a line up (e.g.: in the above example, 69% of the total cost are variable costs, and about 70% of these variable costs come from inputs where the cost of mineral fertilizers account for about 35%);
- the **Incomes** section displays first a total in bold characters, and then its origins, i.e. sales and/or subsidies; a percentage on the right side of each value is also displayed to see the share of each source of revenue; future Agropol versions will display in this section the quantities obtained from the field (screen 09B), so that costs and incomes could be studied not only per unit of area as it is currently the case;
- The **Profit** section displays the Net margin (Total incomes – Total costs) and, on the underneath, the Gross margin (Total incomes – Inputs costs).

Formulas used to compute these costs, incomes and profits are detailed in the VisualBasic code printed in the Annexes.

C A click on the icon displayed on the low-right side of the table opens another table (independent table: see below) for facilitating comparisons of costs/incomes with another set of Parameters and/or with another Package (belonging or not to the same Context).



23. First experiments and conclusions for INSEA

During an INSEA work session in Hamburg on 8-10 May 2006, we collected the cost values currently used by the EU-FASOM and EFEM models for wheat production in France and Germany, in order to compare them with the ones currently available in AGROPOL.

For the EU-FASOM model under construction for the EU-25 regions (Uwe Schneider, Hamburg University, Gremany), the production costs of the various EU agricultural outputs is a priori a challenge not yet meet since these data have been extracted from the 2002 FADN database where costs are not detailed by productions but by farm types. A rather easy and quick way to get these farm costs by production is to break them down according to the market values of the different outputs, fortunately available in the FADN database. These estimates made by U. Schneider are very provisional results (see table below for soft wheat in France and Germany) until more sophisticated methods can be tried, extended and implemented, like the Butault's one today used from time to time by the French Ministry of Agriculture (Butault *et al.*, 1988).

FASOM/FADN		AGROPOL potential presentation							
		EUR2002/ha	**France**		**686,67**	EUR2002/ha	**Germany**		**744,72**
		COSTS				**COSTS**			
		FIXED costs		138,74	*20%*	FIXED costs		261,13	*35%*
Rent	Eur/ha	Land	138,74	*100%*		Land (rent)	261,13	*100%*	
		Assets				Assets			
		- Depreciation				- Depreciation			
		- Interests				- Interests			
		- Tax				- Tax			
		- Insurance				- Insurance			
		- Shelter				- Shelter			
		VARIABLE costs		547,92	*80%*	VARIABLE costs		483,58	*65%*
		Assets				Assets			
		- Maintenance				- Maintenance			
		- Fuel				- Fuel			
		- Motor oil				- Motor oil			
		- Electricity				- Electricity			
		Labour		219,56		Labour		161,56	
		- Unskilled work				- Unskilled work			
Wages	Eur/ha	- Farmer work	219,56	*100%*		- Farmer work	161,56	*100%*	
		- Specialist work				- Specialist work			
		Inputs		328,36		Inputs		322,03	
		- Seeds, plants				- Seeds, plants			
		- Org. fertilizers				- Org. fertilizers			
Fertilizer	Eur/ha	- Min. fertilizers	126,31	*38%*		- Min. fertilizers	94,75	*29%*	
Pesticides	Eur/ha	- Pesticides	131,15	*40%*		- Pesticides	101,10	*31%*	
Water	Eur/ha	- Water	6,43	*2%*		- Water	9,20	*3%*	
Fuel	Eur/ha	- Fuel	31,98	*10%*		- Fuel	84,29	*26%*	
Electricity	Eur/ha	- Electricity	11,58	*4%*		- Electricity	19,15	*6%*	
Heat	Eur/ha		20,90	*6%*			13,54	*4%*	
Input Cost	Eur/ha		252,62				190,45		
FarmLabour	hrs/ha		42,03				38,74		
HiredLabour	hrs/ha		26,80				20,23		
Wage	Eur/hr		8,19				7,99		
Wage	Eur/ha		563,90				470,89		
Yield	tons/ha		7,33				6,53		

For the EFEM model focused on the Baden-Wuerttemberg Lander in the region of Stuttgart (Daniel Blank, Hohenheim University, Germany), only variable costs are currently used for wheat and other productions: some time was therefore spent with D. Blank to keyboard with

AGROPOL the data and the parameters required for assessing the fixed costs. In this process, assumptions – sometimes based on the French case – have here and there replaced the "real" data because no farmer or real expert of German wheat production was immediately available. These assumptions were extended to other data, like for the exact amount of subsidy for wheat in 2003 (392 Euros per hectare have been keyboarded as in the French case for 2005).

For the French case, we keyboarded with AGROPOL rather detailed data available on internet for the 2005 wheat production of the Arvalis-Boigneville experimental farm in the South of Paris (www.fermarvalis.arvalisinstitutduvegetal.fr). Like for the German case (Baden-Wuerttemberg), assumptions were necessary, especially on the assets used since no information was immediately available on this aspect. For the rental value, no data was keyboarded at all.

The Figure 6 displays the results obtained with two simulations in each cases. The first conclusion is on the rental value of land, which should be set aside for good comparisons:
- this is the highest cost (also with the FADN data rather reliable for this value) which consequently impacts a lot the net margin: if we use the German value for both cases, the profit becomes negative;
- this rental value is debatable for many reasons, one being that in the Baden-Wuerttemberg's case, its rather high amount is due to the proximity of the town Stuttgart.

If we remove the rental value of land from the costs, we reached the following conclusions after this very unfinished experimental analyse.

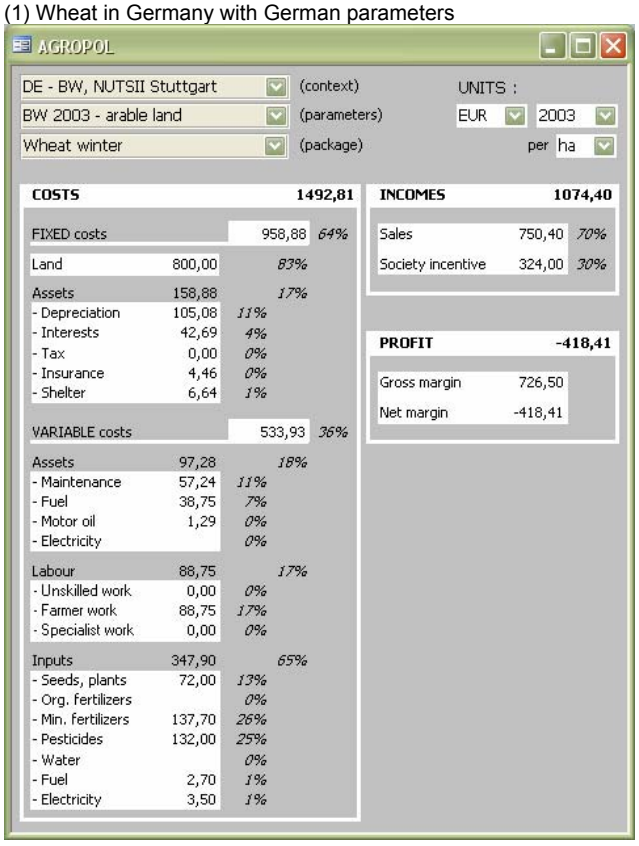
(1) For the same yield per hectare (about 7 tonnes of grain), the production of wheat is a little bit costlier in Germany (about 670 Euros without the rent land) than in France (about 600 euros). This seems due to higher variable costs (about 80% of the total costs in Germany against 68% in France), especially for the pesticides as well as the maintenance of assets which are less capital intensive (smaller capacities) than in France;

(2) As expected, the current EU-FASOM cost values deducted from the FADN need to be revisited first of all because they do not account for the assets which impact both fixed and variable costs. Few case studies with AGROPOL like the ones done here for wheat in Germany and France would help to either check a method for extracting production cost from the FADN, or to give values which can hardly be found elsewhere.

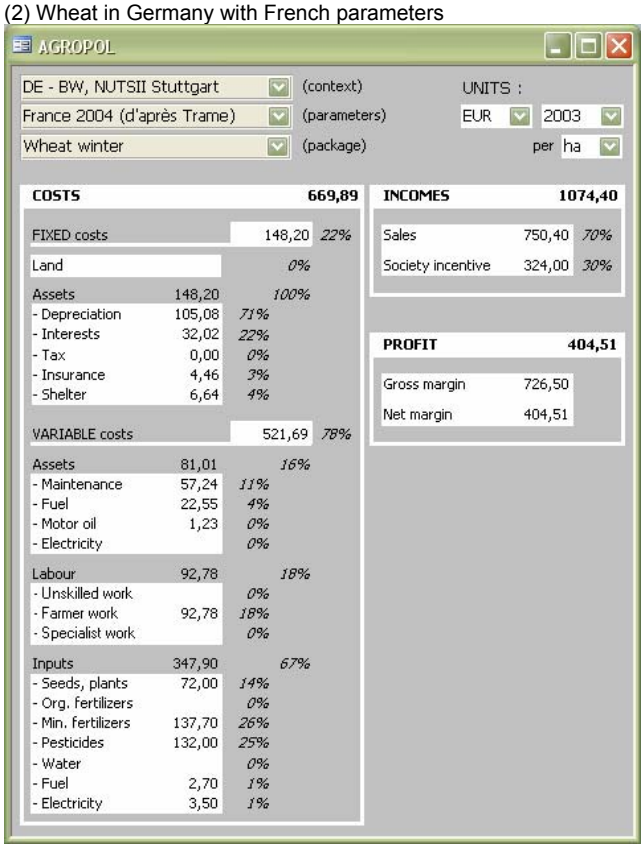
(3) For INSEA models like EU-FASOM, EFEM or AROPAJ, AGRIPOL is definitely of interest for assessing both:
- the sensitivity of costs to certain parameters (price of fuel for example, or of labour);
- the cost of some technical packages which are marginal or not yet existing in Europe, whereas these packages (agro-forestry for example) may be widespread in the years to come (the European potential for agro-forestry would be of about 90 millions hectares) (Dupraz *et al.*, 2005). Indeed, and fortunately, options for the future does not all rely on past observations or trends.

Figure 6. Comparison of wheat costs and incomes between a German farm and a French farm

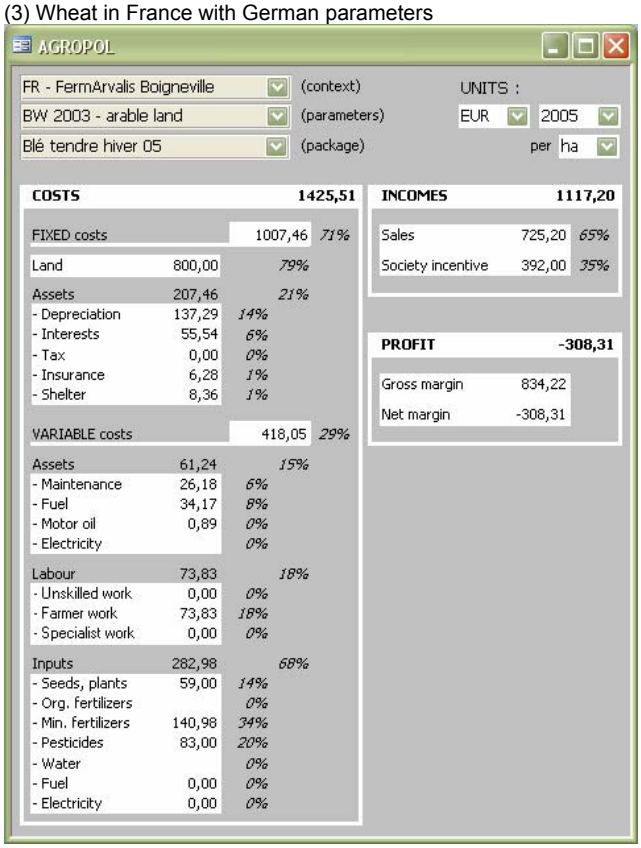
(1) Wheat in Germany with German parameters



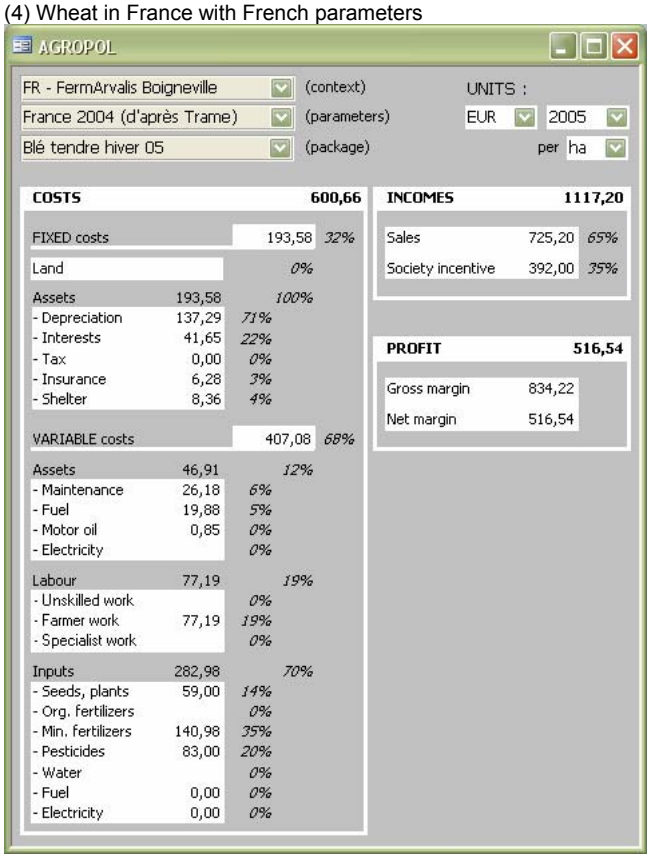
(2) Wheat in Germany with French parameters



(3) Wheat in France with German parameters



(4) Wheat in France with French parameters



ANNEX 1. Tentative characterization of technical packages by Agripol

Source : Deybe et Fallot (2002: Annexe B)

Table A – Definition of techniques for livestock activities

LIVESTOCK	**Traditional**					**Improved**					**Intensive**					**Optimal**
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
the **animal**																
breeding					**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	x
high genetic merit cow							**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	x
younger slaughter														**x**	**x**	x
the **feed**																
concentrates (silage)			**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	x
concentrates (grains)				**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	x
NSC									**x**	**x**	**x**	**x**	**x**	**x**	**x**	x
extra fat						**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	x
propionate precursors												**x**	**x**	**x**	**x**	x
the **feeding**																
increased feed intake		**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	x
in feedlots (≠ outdoor only)					**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	x
optimal level of intake										**x**	**x**	**x**	**x**	**x**	**x**	x
physical treatment of feed								**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	x
chemical treatment											**x**	**x**	**x**	**x**	**x**	x
manure handling																
manure indoor						**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	x
manure removed from stable										**x**	**x**	**x**	**x**	**x**	**x**	x
manure removed and stored in cool														**x**	**x**	x
manure valorisation																
manure handled to fertilize fields					**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	x
manure in farmscale biodigester													**x**	**x**		
manure in centralised biodigester															**x**	x

Table B– Definition of techniques for rice cultivation

RICE CULTIVATION	**Basic**		**Improved**				**Advanced**			**Optimal**
	1	**2**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	
water regime										
non-irrigated [1]	×	×								
irrigated continuously flooded [2]					×	×				
irrigated with drainage (irrigated) [2]							×	×	×	×
deep water [3]			×	×						
fertilisation practice										
organic matter	×									
optimised organic amendment [4]		×	×		×		×			
mineral fertilizer (urea, …)				×		×	×	×	×	×
sulfate-containing fertilizer										×
rice cultivar										
unspecified cultivar	×	×	×	×	×	×				
low CH_4 emitting cultivar							×	×	×	×
cultural practice										
transplanting	×	×	×	×	×	×				
direct seeding							×	×	×	×
wet tillage					×	×	×	×		

Table C– Definition of techniques for fertilised crops

FERTILISED CROPS	**Traditional**					**Improved**					**Intensive**					**Optimal**
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
precision farming																
enhanced spreader maintenance[5]		**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	x
optimised distribution geometry								**x**	**x**				**x**			
site specific application										**x**	**x**	**x**		**x**	**x**	x
matching N to needs																
soil testing							**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	x
allowing for manure N + residual N													**x**	**x**	**x**	x
tools to measure N status of crop												**x**	**x**	**x**	**x**	x
targeted use of fertilisers																
split application			**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	x
controlled release fertilisers																x
nitrification inhibitors																x
fertiliser form[6]									**x**	**x**	**x**	**x**				
slurry injection										**x**	**x**	**x**	**x**	**x**	**x**	
foliar application											**x**	**x**				
other																
fertiliser free zone					**x**		**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	
minimise fallow periods						**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	
water management				**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	

[5] reduce kgN/ha/yr by 15% for grass, 15% for maize
[6] liquid or powder

Table D– Definition of techniques for new pastures

PASTURE	Traditional					Improved					Intensive					Optimal
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
pasture type																
deep-rooted herbs		x	x	x	x	x	x	x	x	x	x	x	x	x	x	
optimised distribution geometry			x	x	x	x	x	x	x	x	x	x	x	x		
precision farming																
enhanced spreader maintenance[7]						x	x	x	x	x	x	x	x	x	x	
optimised distribution geometry			x	x	x	x	x	x	x	x	x	x	x			
site specific application														x		
matching N to needs																
soil testing						x		x	x	x	x	x	x	x		
tighten N flow cycle[8]						x										
crop tools to measure their N status															x	
targeted use of fertilisers																
split application									x							
controlled release fertilisers										x						
nitrification inhibitors												x	x	x	x	
fertiliser form											x	x	x	x	x	
other																
increase in the cutting frequency					x	x	x	x	x	x	x					
fertiliser free zone				x	x	x	x	x	x	x	x					

[7] Reduce kgN/ha/yr by 15% for grass, 15% for maize
[8] Manure reuse in plant production, plant residue N (crop residues) maintained on production site

ANNEXE 2. VisualBasic code for costs and incomes computation in AGROPOL

```
Function Calcul_cost() As Boolean

filtrePARTNER = "[partner_key]=" & [Partner]
filtreCONTEXT = "[context_key]=" & [Context]
filtrePARAM = "[param_key]=" & [Param]
filtrePACK = "[pack_key]=" & [Package]

discount_rate = DLookup("[discount_rate]", "TEKparam", filtrePARAM)
currency_code = DLookup("[currency_code]", "TEKpack", filtrePACK)
currency_year = DLookup("[currency_year]", "TEKpack", filtrePACK)

' Attention : prévoire utilisation fréquence job
' Attention : prévoire utilisation year=n et discount rate
' Attention : veiller que unités de surface/volume/etc ne perturbent pas

' FIXED COSTS
' -----------

cost_fixed_land = DLookup("[land_price]", "TEKparam", filtrePARAM)

cost_depreciation = _
 DSum("" _
 & "((1-(1-[asset_depreciation_rate])^[asset_depreciation_life])/ " _
 & "[asset_depreciation_life]*[asset_price])/ " _
 & "([asset_use_annual]/[asset_performance]) " _
 & "* [asset_speed]*24*[asset_coverage]", "" _
 & "Q_Cost_Asset")

cost_interest = _
 DSum("" _
 & "(((1-(1-[asset_depreciation_rate])^[asset_depreciation_life])/ " _
 & "[asset_depreciation_life]*[asset_price])*[interest_lt_rate]/[asset_depreciation_rate])/ "
_
 & "([asset_use_annual]/[asset_performance]) " _
 & "* [asset_speed]*24*[asset_coverage]", "" _
 & "Q_Cost_Asset")

cost_tax = _
 DSum("" _
 & "([asset_price]*[asset_tax_rate])/ " _
 & "([asset_use_annual]/[asset_performance]) " _
 & "* [asset_speed]*24*[asset_coverage]", "" _
 & "Q_Cost_Asset")

cost_insurance = _
 DSum("" _
 & "([asset_price]*[asset_insure_rate])/ " _
 & "([asset_use_annual]/[asset_performance]) " _
 & "* [asset_speed]*24*[asset_coverage]", "" _
 & "Q_Cost_Asset")

cost_shelter = _
 DSum("" _
 & "([asset_price]*[asset_shelter_rate])/ " _
 & "([asset_use_annual]/[asset_performance])" _
 & "* [asset_speed]*24*[asset_coverage]", "" _
 & "Q_Cost_Asset")

cost_fixed_asset = _
 Round(Nz([cost_depreciation]) + Nz([cost_interest]) _
 + Nz([cost_tax]) + Nz([cost_insurance]) + Nz([cost_shelter]), 2)

cost_fixed = Nz([cost_fixed_land]) + Nz([cost_fixed_asset])


' VARIABLE COSTS
' --------------

cost_rm = _
 DSum("" _
 & "[asset_rm_cost] " _
 & "*[asset_speed]*24*[asset_coverage]", "" _
 & "Q_Cost_Asset")
' Attention : " * [uu_X1]" dans formule initiale

cost_fuel = _
 DSum("" _
 & "[asset_power]*[asset_load]*[asset_fuel_conso]*[diesel_price] " _
 & "*[asset_speed]*24*[asset_coverage]", "" _
 & "Q_Cost_Asset")
' Attention : diesel_price provisoire (prévoir divers prix fuel
```

```
cost_lube = _
 DSum("" _
 & "([asset_lube_carter]/[asset_lube_change])*1.25*[lube_price] " _
 & "*[asset_speed]*24*[asset_coverage]", "" _
 & "Q_Cost_Asset")

' cost_electricity = _
' Attention : prévoire calcul à terme

cost_variable_asset = _
 Round(Nz([cost_rm]) + Nz([cost_fuel]) _
 + Nz([cost_lube]) + Nz([cost_electricity]), 2)

cost_labour1 = _
 DSum("" _
 & "[labour1_time]*24*labour_level1_price", "" _
 & "Q_Cost_labour")

cost_labour2 = _
 DSum("" _
 & "[labour2_time]*24*labour_level2_price", "" _
 & "Q_Cost_labour")

cost_labour3 = _
 DSum("" _
 & "[labour3_time]*24*labour_level3_price", "" _
 & "Q_Cost_labour")

cost_variable_labour = _
 Round(Nz([cost_labour1]) + Nz([cost_labour2]) _
 + Nz([cost_labour3]), 2)

cost_input_seed = DSum("[inseed_cost]", "TEKinput_seed", filtrePACK)
cost_input_manure = DSum("[inmanure_cost]", "TEKinput_manure", filtrePACK)
cost_input_fertilizer = DSum("[infertilizer_cost]", "TEKinput_fertilizer", filtrePACK)
cost_input_pesticide = DSum("[inpesticide_cost]", "TEKinput_pesticide", filtrePACK)
cost_input_water = DSum("[inwater_cost]", "TEKinput_water", filtrePACK)
cost_input_fuel = DSum("[infuel_cost]", "TEKinput_fuel", filtrePACK)
cost_input_electricity = DSum("[inelectricity_cost]", "TEKinput_electricity", filtrePACK)

cost_variable_input = _
 Round(Nz([cost_input_seed]) + Nz([cost_input_manure]) + Nz([cost_input_fertilizer]) _
 + Nz([cost_input_pesticide]) + Nz([cost_input_water]) + Nz([cost_input_fuel]) _
 + Nz([cost_input_electricity]), 2)

cost_variable = cost_variable_asset + cost_variable_labour + cost_variable_input

cost_total = cost_fixed + cost_variable


' INCOMES
' -------

income_sale = DSum("[output_qty]*[output_price]", "TEKoutput", filtrePACK)
pack_subsidy = DLookup("[pack_subsidy]", "TEKpack", filtrePACK)
income_subsidy = pack_subsidy + DSum("[output_qty]*[output_subsidy]", "TEKoutput", filtrePACK)
income_total = Nz(income_sale) + Nz(income_subsidy)
profit_gross = income_total - cost_variable_input
profit_net = income_total - cost_total
profit = profit_net
```

Bibliographic references

BCMA, 2004. TRAME. Coût prévisionnel indicatif 2004 des machines agricoles, Bureau de Coordination du Machinisme Agricole, Paris, Juin, 18 p.

Butault J.P., Carles R., Hassan D., Reignier E., 1988. Le coût de production de divers produits agricoles dans la CEE, Archives et documents 260, Institut National de la Statistique et des Etudes Economiques, Octobre.

Carpy-Goulard Françoise, 2001. Analyse des relations agriculture-environnement par couplage d'un modèle économique à des indicateurs environnementaux. Application au secteur des grandes cultures de la région Midi-Pyrénées, Thèse de doctorat en sciences économiques, Université Montpellier I, Montpellier, 324 (+annexes) p.

Desbois Dominique, 2000. Evaluation micro-économique de la marge brute standard sur la base du RICA, Institut National de la Recherche Agronomique, Paris, Décembre, 21 p. (http://www.inra.fr/Internet/Departements/ESR/vie/animations/Ecoprod/pdf/desbois.pdf)

Deybe Daniel, Fallot Abigaïl, 2002. Marginal abatement cost functions modelling for land-use related ressources, Working Paper, Centre de Coopération Internationale en Recherche Agronomique pour le Développement, Nogent sur Marne, June, 48 p.

Deybe Daniel, Fallot Abigaïl, 2003. "Non-CO2 Greenhouse Gas Emissions from Agriculture: Analysing the Room for Manoeuvre for Mitigation, in Case of Carbon Pricing", 25th International Conference of Agricultural Economists, Durban, 16-22 August, International Association of Agricultural Economists

Dixon J., Gulliver A., Gibbon D., 2001a. Global Farming Systems Study: Challenges and Priorities to 2030. Synthesis and Global Overview, Food and Agricultural Organization of the United Nations, 98 p. (http://wbln0018.worldbank.org/essd/rdv/vta.nsf/5f265c629632b34085256984006d3654/ed94321bbcd71f3c85256a18005e9e19/$FILE/Global+Study.pdf)

Dixon J., Gulliver A., Gibbon D., 2001b. Systèmes d'exploitation agricoles et pauvreté. Améliorer les moyens d'existence des agriculteurs dans un monde changeant, Food and Agricultural Organization of the United Nations, Rome, 455 p.

Dorin Bruno, 2005. Impact d'une tarification des émissions de gaz à effet de serre sur les agricultures européennes. Configuration, résultats et propositions de consolidation du modèle Agripol. Rapport final pour le programme GICC 07-A/2002, CIRAD, Montpellier, Octobre, 37 p.

Dupraz C., P. Burgess, A. Gavaland, A. Graves, F. Herzog, L. Incoll, N. Jackson, K. Keesman, G. Lawson, I. Lecomte, F. Liagre, K. Mantzanas, M. Mayus, G. Moreno, J. Palma, V. Papanastasis, P. Paris, D. Pilbeam, Y. Reisner, W. Werf Van der, 2005. Synthesis of the Silvoarable Agroforestry For Europe project, INRA-UMR System Editions, Montpellier, 254 p.

Fischer Jürg, 1999. Energy Inputs in Swiss Agriculture, Working Paper 99-01, Common Agricultural Policy Regional Impact analysis, Bonn, 19 p. (ftp://ftp.agp.uni-bonn.de/pub/papers/PAP99-01.zip)

Gérard F., Erwidodo, Marty I., 2000. "Evaluation of the Impact of Trade Liberalisation on Food Crop Production and Farm Income in Lowland Java, Indonesia", in Peter G.H., Von Braun J. (Dir.), Food security, diversification and resource management: refocusing the role of agriculture, Proceedings of the 23rd international conference of agricultural economists, Ashgate

IPCC, 1996. Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reporting Instructions (Volume 1), Intergovernmental Panel on Climate Change, http://www.ipcc-nggip.iges.or.jp/public/gl/invs4.htm (21/08/2003)

IPCC, 2001. Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, Intergovernmental Panel on Climate Change, http://www.ipcc-nggip.iges.or.jp/public/gp/french/gpgaum_fr.htm
http://www.ipcc-nggip.iges.or.jp/public/gp/english/ (09/09/2004)
IPCC, 2003a. Good Practice Guidance for Land Use, Land-Use Change and Forestry, Intergovernmental Panel on Climate Change, http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_contents.htm (09/09/2004)
IPCC, 2003b. Tools for Estimation of Changes in Soil Carbon Stocks associated with management Changes in Croplands and Grazing Lands based on IPCC Default Data (Annex 4A.1), Intergovernmental Panel on Climate Change, http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/annex4a1.htm (09/09/2004)
Malassis Louis, Padilla Martine, 1986. Economie agro-alimentaire. L'économie mondiale (III), Cujas, Paris, 449 p.
Mazoyer Marcel, Roudart Laurence, 1997. Histoire des agricultures du monde. Du néolithique à la crise contemporaine, Seuil, Paris, 546 p.
MEA, 2005. Ecosystems and Human Well-being: Synthesis, Millennium Ecosystem Assessment, World Resources Institute, Whashington D.C., 155 p. (http://www.millenniumassessment.org/proxy/document.356.aspx (15/09/2005))
PACIFIC, 2006. PACIFIC Exchange Rate Service, University of British Colombia, Vancouver, Canada, http://fx.sauder.ubc.ca/ (13/01/2006)
Pollet Pascale, Butault J.P., Chantry E., 2001. The Agricultural Production Costs Model, Institut National de la Statistique et des Etudes Economiques, Paris, 80 p.
Ponsioen T.C., Laborte A.G., Roetter R.P., Hengsdijk H., Wolf J., 2003. TechnoGIN-3: a technical coefficient generator for cropping systems in East and Southeast Asia, Quantitative Approaches in Systems Analysis 26, PE&RC, Wageningen, December, 72 p.
Rotz C. Alan, Coiner Colette U., 2005. The Integrated Farm System Model, Reference Manual Version 1.4, United States Department of Agriculture, Whashington D.C., May, 137 p. (http://www.ars.usda.gov/SP2UserFiles/Place/19020000/ifsmreference.pdf (12/08/2005))
Slinsky Stephen P., Tiller Kelly H., 1999. Application of an Alternative Methodological Approach for Budget Generators for Research, http://apacweb.ag.utk.edu/ppap/pdf/99/saeaabs.pdf (01/04/2005)